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A STUDY OF MENARCHEAL AGE AND ITS CONTRIBUTING FACTORS BETWEEN URBAN AND RURAL GIRLS

BY

AIMORN PASIPHOL

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A THESIS SUBMITED IN PARTIAL FULFILMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE IN PUBLIC HEALTH
(NUTRITION)

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กองทั่วไป

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Abstract

One hundred and twenty-seven of school girls with the assign criteria, who attained their first menstruation in Bangkok and Banna, Nakornnayok were recruited as the study subject. The data collected included the anthropometric measurement, family and socio-economic background and dietary consumption. The better nutritional status has been found to significantly lower the age at menarche ($F = 11.971$, $p = 0.001$) The amount of protein consumption exerts its effect in lowing the age at menarche only in those who have good nutritional status. The socio-economic status, indicated by the girls luncheon allowance, also has a negative association with the age at menarche, ($F = 5.838$, $p = 0.018$) which might be through the higher amount of animal protein consumption. No difference has been found in the age of menarche between urban and rural girls.

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ชื่อวิทยานิพนธ์ การศึกษาความแตกต่างและ ปัจจัยที่มีอิทธิพลต่ออายุของการมีระดูครั้งแรกของเด็กหญิงในเมืองและชนบท (ศึกษาเปรียบเทียบเฉพาะกรณีในกรุงเทพมหานคร และจังหวัดนครนายก)

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บทคัดย่อ

การศึกษาครั้งนี้ มีวัตถุประสงค์เพื่อศึกษาหาปัจจัยที่มีอิทธิพลต่ออายุของการมีระดูครั้งแรก โดยเก็บข้อมูลจากเด็กในกรุงเทพฯ และเด็กในตำบลบ้านนา อำเภอบ้านนา จังหวัดนครนายก จากโรงเรียนที่เลือกไว้ ในระหว่างวันที่ 15 มิถุนายน 2528 จนถึงวันที่ 30 พฤศจิกายน 2528 โดยมีกลุ่มตัวอย่างทั้งหมด 127 คน เป็นเด็กในกรุงเทพฯ 67 คน เด็กในบ้านนา 60 คน ผู้วิจัยได้ทำการชั่งน้ำหนัก, วัดส่วนสูง, เส้นรอบแขน และปริมาณไขมัน ใต้ผิวหนังที่แขนซ้าย (tricep skinfold) กับเด็กตัวอย่างที่มีระดูครั้งแรกภายใน 2 สัปดาห์ และให้ตัวอย่างตอบแบบสอบถามเกี่ยวกับข้อมูลทั่วไป, เศรษฐกิจสังคม, พฤติกรรมเกี่ยวข้องกับสิ่งแวดล้อม , ความถี่ของการบริโภคโปรตีน และบันทึกอาหารที่บริโภคในแบบบันทึก เป็นเวลา 3 วัน ซึ่งผู้วิจัยจะถามอาหารย้อนหลังจากที่บันทึกวันต่อวัน เป็นเวลา 3 วัน ผลการวิเคราะห์พบว่า ภาวะโภชนาการเป็นปัจจัยที่สำคัญที่มีผลต่ออายุของการมีระดูครั้งแรก โดยพบว่า เด็กที่มีภาวะโภชนาการดีมีอายุของการมีระดูครั้งแรกต่ำกว่าเด็กที่มีภาวะโภชนาการต่ำอย่างมีนัยสำคัญทางสถิติ (F = 11.971, p-value = 0.001) ส่วนฐานะเศรษฐกิจพบว่า เงินค่าอาหารกลางวันเป็นตัวแปรที่มีผลต่ออายุของการมีระดูครั้งแรก และอาหารโปรตีนมีผลต่ออายุระดูครั้งแรกเฉพาะในกลุ่มที่มีภาวะโภชนาการดีเท่านั้น สำหรับปัจจัยทางด้านสิ่งแวดล้อมในเมืองและชนบทในการวิจัยครั้งนี้ ไม่พบความสัมพันธ์ต่ออายุของการมีระดูครั้งแรกอย่างมีนัยสำคัญทางสถิติ

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CHAPTER I

Introduction

Human health is the most important factor in the development of a country. A major determinator that influences a human's quality of life is nutrition. It has been postulated that undernutrition affects reproductive ability by shortening the duration of the reproductive lifespan and reducing its efficiency. Menarche has important implications in the biology of reproduction. The relationship of the nutritional status to menarche has been postulated on the basis of three general types of observations.

First, there is the documented secular decline in the age of menarche in many western countries. For example, in 1968 Tanner reviewed the literature on the changing age at menarche in a number of European countries and noted that over the past century there has been a correlation in the decline in the age of the onset of menarche with an increase in height and weight by age. (Tanner 1968)

The second line of evidence comes from observations on variations in menarche associated with socio-economic status. For example, higher age in the start of menarche are reported in nations where nutritional status has remained inadequate. In rural Bangladesh, Chowdhury et. al.(1976) reported the median age of menarche at 15.8 years for Muslims and 16.0 years for Hindus. This data may be compared with the present age of menarche in the United States which is estimated to be at12 - 13 years by Zacharias et. al. Since Socio-economic conditions are more closely related to the nutritional status in developing countries,

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socio-economic or urban-rural differentials in menarche may also be observed. Burrell et. al.(1961) reported the average age of the start menarche for South African Bantus 15.02 years for those classified as not poor and 15.42 for those classified as poor. Madhavan in 1965 estimated the mean age of the start menarche in Madras, India, at 12.76 years for urban areas and 14.16 years for rural areas, similarly in Kerala, the differentials were 13.24 for urban areas and 14.41 for rural areas.

The third line of evidence relating nutritional status to menarche comes from studies which have sought direct correlations. A study in Uttar Pradesh, India, in 1974 by Bhalla and Srivastava reported that girls of better nutritional status who received diets higher in calories and proteins showed earlier menarche. Similarly, a study by Kraij -Cercek of Slovak girls in 1956 found that those with diets rich in protein reached menarche at 12.7 years compared with 14.1 years for those with diets composed mostly of carbohydrates.

Recently, many investigations have shown a certain relationships between menarcheal age and miscarriage rate. (Liestøl. 1980, Martin et. al. 1983 , Wyshak 1983, Sandler et.al. 1984) The misscarriage rate is found to be low at intermediate menarcheal ages, and higher for both early and late menarcheal ages. (Martin et. al. 1983). The results are shown in table 1 which are similar to that observed by Wyshak (1982).

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Table 1 Miscarriage rate for the first five pregnancies as a function of menarcheal age (data from the Breast Cancer Detection Demonstration Project)

Menarcheal age (years)	Pregnancy no. 1		2		3		4		5		Total	
	No*	%	No.	%	No.	%	No.	%	No.	%	No.	%
< 12	22/166	13.3	11/125	8.8	10/73	13.7	4/29	13.8	0/10	0.0	17/403	11.7
12	31/250	12.3	22/202	10.9	17/114	14.9	4/53	7.5	5/24	20.8	79 64	12.2
13	37/324	11.4	21/248	8.5	12/134	9.0	7/63	11.1	2/29	6.9	79/798	9.9
14	16/176	9.1	20/137	14.6	10/77	13.0	5/35	14.3	1/15	6.7	52/440	11.8
15+	25/151	16.6	11/106	10.4	6/57	10.5	6/25	24.0	1/7	14.3	49/346	14.2
Total	131/1070	12.2	85/818	10.4	55/455	12.1	26/205	12.7	9/85	10.6	306/2633	11.6

* Numbers shown are : number of miscarriages/total number of pregnancies excluding those resulting in an induced abortion and those subsequent to an induced abortion or miscarriage.

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He examined the data concerning age at menarche and unsuccessful pregnancy , for white American Catholics and non-Catholics separately (table 2). For the entire sample and for Catholic women, those with early menarche (under 12) have a greater number of unsuccessful pregnancies (adjusted means). The data for non-Catholics is in the same direction but not statistically significant, Perhaps -

Table 2 Pregnancy outcome by age at menarche.

		Age at menarche			
	Religious affiliation	Under 12	12 or 13	14 or older	P - value
Unsuccessful Pregnancy outcomes	All women	0.54	0.46	0.48	0.005
	Catholic	0.64	0.51	0.59	0.012
	Non-Catholic	0.46	0.41	0.38	0.156
Probability of at least one unsuccessful pregnancy outcome	All women	0.37	0.32	0.33	0.017
	Catholic	0.42	0.36	0.37	0.034
	Non-Catholic	0.33	0.30	0.30	0.401
Probability of difficulty becoming pregnant	All women	0.16	0.12	0.13	0.012
	Catholic	0.14	0.10	0.14	0.162
	Non-Catholic	0.18	0.13	0.12	0.020

All ages are means adjusted by analysis of covariance. Covariates : age, age at first live birth, total number of pregnancies. socio-economic status.

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due to a bias introduced by induced abortions. Those with early menarche also tended to have a higher probability of at least one unsuccessful pregnancy, and to have a higher probability of reporting difficulty in becoming pregnant. The data for Catholic women also shows a curvilinear trend with women of early and late menarcheal age having less favourable experiences than those of intermidiate age at menarche. Nobody has explained this result. The late menarcheal age may be correlated with low socio-economic status and suboptimal nutrition . Since poorly nourished women also have high misscarriage rate, a high incidence of miscarriages may be correlated with late menarcheal age due to this reason. But it is difficult to give the reason for the early menarcheal age group having a higher miscarriage rate. This may be the effect of psycho-social aspects of urban and rural enviroment. Urbanization is one feature of the enviroment that increases over crowdings and stimulation-sensory, social, intellectual, competition and stress. In well developed countries like the United Kingdom and Holland where urbanization has progressed to the point where little difference remains between urban and rural environment urban and rural girls are said to have no difference in the age at menarche. The mean menarcheal age in developed countries is also lower than that in underdeveloped countries. In Africa and Asia, where ways of life still differ greatly between the city and the country, the data is more scanty. This inspired the author to attempt to investigate the effect of urban-rural environment and focus on psycho-social aspects which I think is appropriate for the study of this topic in Thailand becauge ways of life in the urban and rural areas of Thailand are very different.

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This study investigates the important factors which compound to influence the menarcheal age. It is hoped that the result of this study will serve as benefit to the promotion of health and as useful guideline for each girl who will become mothers and be used as base-line data for other reseaches in this related area which would lead to better quality of life.

Objective of this study

to study the factors that influence the menarcheal age. Factors to be investigated are

1. The urban and rural environments
2. The nutritional status
3. The socio-economic status
4. The amount of protein consumption

Hypothesis of this study

1. The average menarcheal age of the urban schoolgirls is lower than that of the rural ones.
2. The average menarcheal age of the well-nourished schoolgirls is lower than that of the undernourished ones.
3. Within the same level of nutritional status, the average age at menarche of girls belonging to the higher socio-economic group is lower than that of the ones belonging to the lower socio-economic group.
4. Within the same level of nutritional status, the schoolgirls who consume high protein diets have a mean menarcheal age lower than the schoolgirls who consume low protein diets.

The Scope of this study

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The selected population are the schoolgirls between the ages

of 10 and 16 years who studies in selected schools in Bangkok, and Ban - na, Nokornnayok area only.

Assumptions of this study

1. The data were correctly recorded and the measurement of all subjects was done by one examiner only throughout the study.
2. The anthropometric data were collected by using the same instrument and comparing with the reference standard.
3. All information was collected from only apparently healthy schoolgirls.

Limitation of this study

1. The purposive sampling method is essential in this study because of its designed. Since the data must be collected from girls within their first two weeks of menarche, any of the girls with specific criteria who experiences her first menstruation during the data collection period naturally becomes a study subject.
2. The study sample size is small because of the limitation of time and transportation.
3. This is a comparative study between two areas and the data has to be collected by the same person at almost the same time so urban and rural areas selected must be within a short travelling distance.

Variables used in this study

All the variables in this study are used as follows : -

1. Independent variables : urban and rural environments

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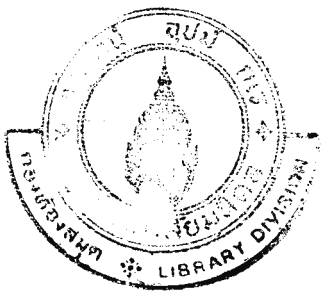
: nutritional status

: socio-economic status

: protein consumption

2. Dependent variables : menarcheal age



Definition of terms

Terminology used in this study were defined as follow : -

1. "Urban" : the area in Bangkok where children are exposed to sexual stimulation such as theatres, disco-theques, skating rinks etc.
2. "Rural" : the area in Ban-na, Nokornnayok where children have lesser exposure the above mentioned sexual stimulation.
3. "Menarcheal age" : the first age of menstruation cycle.
4. "Psychosocial characteristics" : in this study means the social behavior of the subject in relation to their social enviroment. Characterized from dating with boyfriends, skating, dancing in disco-theques, watching televison, movies and reading magazines.
5. "Sexual stimuli scores" : the scores that are calculated from the behavior in relation to mating with the opposite sex, perception of sexual relations between man and woman.
6. "Nutritional status" : the level of the nutritional status is justified from measurements of body weight and height at age intervals and the subjects are classified as well-nourished and under-nourished by using the weight for height and weight for age prepared by Burana Chavalitthumrong et.al. at 50^{th} percentile of the reference standard weight for height and weight for age.(see appendix E.)
7. "Socio-economic status" : the data collected from per capita income

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and daily luncheon allowance, The subjects are classified as higher and lower socio-economic group according to the 50^{th} percentile of the daily luncheon allowance of the students in each school grade. (see appendix A.)

8. "Protein consumption" : the level of protein consumption is justified from both of subject individual food record and protein consumption pattern scores, classified into two level, higher and lower protein consumption. Higher means to protein intake is not less than 75 % of RDA (WHO, 1985, see appendix E) and protein consumption pattern scores is not less than the 50^{th} percentile of total scores. Lower means to pretein intake is lower than 75 % of RDA and, or protein consumption pattern scores is lower than the 50^{th} percentile of total scores. (see appendix A)

9. "Protein consumption pattern scores" : are calculated from the frequency of protein consumption on pattern per week. Th data collected from both individual records on questionaire and confirmed by the examiner.(see appendix B)

10. "Body Mass Index" : calculated from weight in kg/ (height in meter)^2

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CHARTER II

Review of Literature

Menarche is the important condition in the sexual life of females. It doesn't only indicate that girls have grown up to be women but it is expected that the manarcheal age effects subsequent reproductive events. It is well known that the menarcheal age varies widely from population to population, being influenced by hereditary and environmental factors. So a study of factors affecting menarcheal age is interesting. The factors to be considered here are heredity, race, nutrition, socio-economic status, physical exertion, geography and psychosocial factor.

1. Hereditary factor It seems that fundamentally, the control of the menarche age is genetical. There is a fairly high correlation between the times of menarche of mothers and daughters (Bolk, 1926; Gould & Gould, 1932) and between sisters (Boas, 1932; Reymert & Jost, 1947) and a very much higher one between identical twins. (Petri, 1935; Tisserand Perrier, 1953)

Table 3 Mean difference, in months, in age at menarche of related and unrelated women

	From Petri (1935)		From Tisserand-Perrier(1953)	
Relationship	No. pairs	Diff. months	No. pairs	Diff. months
Identical twins	51	2.8 ± 0.33*	46	2.2
Non-identical twins	47	12.0 ± 1.62*	39	8.2
Sisters	145	12.9	—	—
Unrelated women	120	18.6	—	—

*Standard error.

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In table 3 the mean difference in months of menarche is given for identical twins, non-identical twins, sibling and unrelated women. The difference is very much less for identical twins than for non-identicals or sisters, but the sister's figures are considerably lower than for unrelated women.

Damon et. al. (1969) reported menarcheal age among 66 mothers and their 78 daughters who were mainly northwest European in origin. Their socio-economic status was modest. The mothers were asked their ages at menarche 12 years after its occurrence, on average, while the daughters' ages at menarche were recorded during a longitudinal growth study. The results of this study appeared that there was a correlation between the mothers' and daughters' age at menarche. The coefficient of the correlation, r, was 0.24 ± s.e. 0.11 ($0.05 > P > 0.01$)

2. Race as a genetic factor. In the past, it was stated frequently that Jewish girls started menstruating early and Eskimo girls late. Ito (1942) showed that in Los Angeles there were significant differences in the ages at menarche of American, European, Japanese, Negro and Chinese girls at the same college in 1940. Averaing 12.5 for those of Mexican origin, 12.9 for Europeans, 13.1 for Japanese and for Negroes and 13.9 for Chinese. However, even this study may not be free from nutritional or socio-economic conditions.

Foll (1961) compared races of Burmese and indian Assamese girls in different enviroments, noted that the mean menarcheal age the Assamese was 13.21 years and for the Burmese, 13.25 years. He concluded that neither race and climate are determining factors. Hooton (1949) and Crossen (1953) believe that race has no influence

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on the menarche. The latter writes, "The importance of race was investigated by Michelson. In a study of White and Negro girls, he concluded that socio-economic circumstances were much more important than race in the differences found. A similar conclusion was reached by Schaeffer in a study of Gentile girls and Jewesses, hence race is probably not a significant factor in the variations in the onset of the menarche". Whether race has influence on the menarche or not. In this study I would controled this factor by selecting the same race samples.

3. Nutrition factor Nutrition has been accepted as an important factor affecting menarcheal age. It means food consumption that affects nutritional status. So I separate there items as follows;

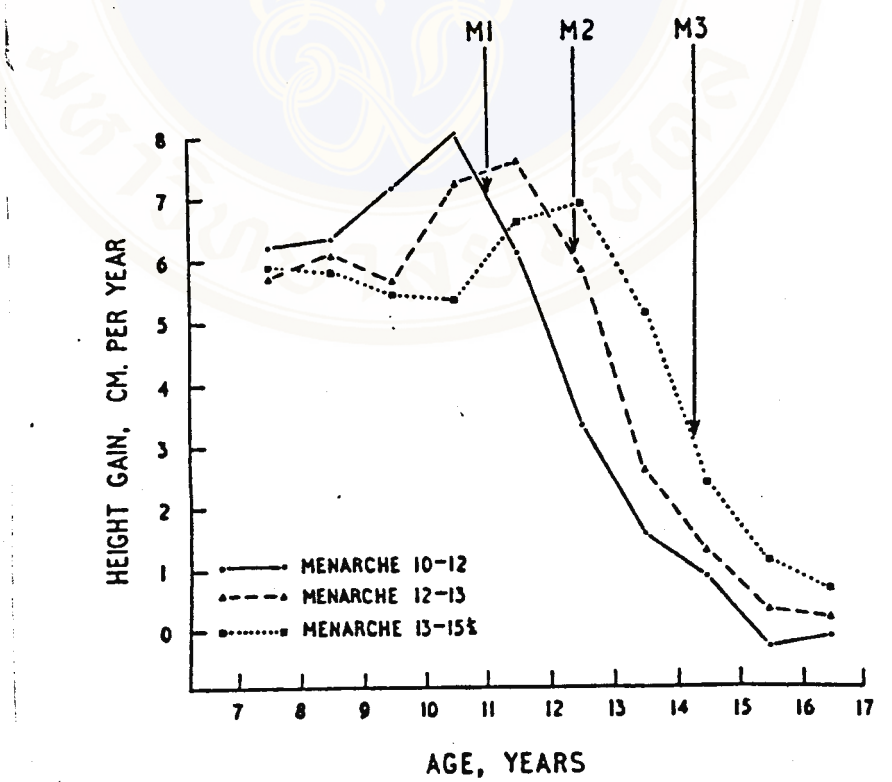

FIG. 1 Relation of peak velocities in height for early, average, and late maturing girls; and of time elapsing between peak velocity and menarche for the three groups.

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3.1 Height velocity There are difference in height velocity between early menarche and late menarche and these differences can be seen both before adolescence has started, and after it is entirely over. The data of Simmons and Greulich (1943), shown in figure 1, exemplify this for the height spurt. The velocity curves of early, average and late maturing girls are shown, with the mean time of menarche for each group indicated by the vertical pointers. The differences between the three groups are clear: the earlier the menarche, the greater the peak velocity; and the earlier the menarche, the less time elapses between it and peak velocity.

Table 4 Correlation beween age at menarche and skeletal age (todd standards) for ages 7 to 16 years (Brush Foundation data, from simmons & greulich, 1943)

Chronological age (years)	Number of girls	Correlation coefficient, age at menarche and skeletal age
7	64	-0.51 ± 0.09
8	73	-0.46 ± 0.09
9	79	-0.48 ± 0.09
10	124	-0.59 ± 0.06
11	159	-0.69 ± 0.04
12	191	-0.80 ± 0.03
13	178	-0.85 ± 0.02
14	166	-0.86 ± 0.02
15	134	-8.83 ± 0.03
16	106	-0.78 ± 0.04

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3.2 Skeletal age Age at menarche is related to skeletal age. The data is more scanty, since it has to be longitudinal. Table 4 gives figures for the correlation of age at menarche with skeletal age every year back as far as 7. (Simmons and Greulich, 1943) The correlations, as one would expect, get smaller as one goes back from adolescence, but they remain quite high, showing the relative consistancy of skeletal maturity.

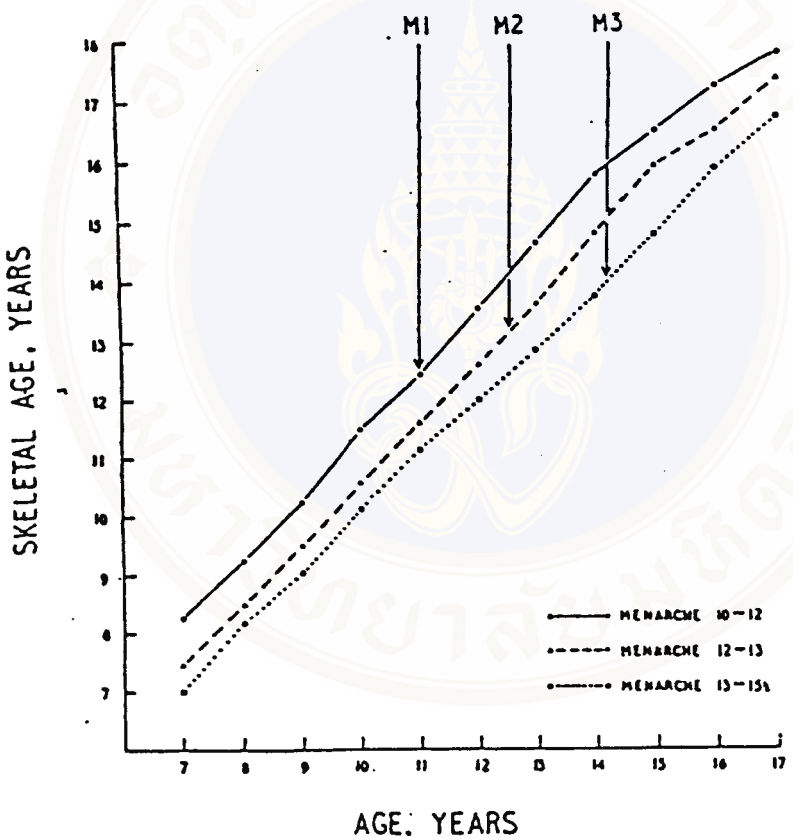

FIG. 2. Relation of skeletal maturity and age at menarche. Skeletal development ages (Todd Standards) for early-, average- and late-menarche groups of girls, from age 7 to maturity. M1, M2, M3, average time of menarche for each group. Mixed longitudinal data. (Redrawn from Simmons & Greulich, 1943.)

The same point is made graphically in figure 2, drawn from the same data. Here early, medium and late menarche groups are seen to maintain their relative positions in skeletal age in relation to chronological age all the way back to age 7. Not only are the early

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matures of greater skeletal age than late maturers at the time of their adolescence but also at age 7.

Table 5 Comparison of chronologic ages at menarche, skeletal ages at menarche, and pre- and postmenarcheal rates of skeletal maturation in 30 undernourished and 30 well-nourished girls

	Under-nourished group	*Well-nourished group*	*Difference*	*Standard error of difference between means*	*Actual difference between means/Standard error of difference between means*	*Level of significance*
Chronologic age at menarche (months)						
Mean ± σ*	173.4 ± 9.56	149.2 ± 10.59	24.2	2.606	9.38	<.001
Range	158-201	120-168				
Skeletal age at menarche (months)						
Mean ± σ	159.3 ± 9.24	155.5 ± 12.01	3.8	2.768	1.37	>.05
Range	146-191	132-179				
Premenarcheal rate (bone age per calendar month)						
Mean ± σ	0.92 ± 0.029	1.04 ± 0.073	0.12	0.015	8.28	<.001
Range	0.87-0.96	0.94-1.20				
Postmenarcheal rate (bone age per calendar month)						
Mean ± σ	1.07 ± 0.089	1.03 ± 0.172	0.04	0.353	1.14	>.05
Range	0.93-1.20	0.81-1.44				

*σ, Standard deviation.

Dreizen et. al. (1967) studied 30 undernourished and 30 well-nourished girls from early childhood to early adulthood. Each subject in both groups was white, native born, and of British extraction. Every family had lived in north central Alabama for several generations. Skeletal age assessments extending from between 4 and 5 years of age to skeletal maturity were made for each girls from serial sequential roentgenograms of the left hand and wrist taken every six months. The study showed that the mean rate of skeletal maturation of the undernourished group increased significantly after menarche whereas the mean pre-and postmenarcheal rates of the well-nourished group were almost identical. (shown in table 5)

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This evidence indicates that the early menarche group have a higher and more regular rate of skeletal maturation before menarche than the late menarche group.

3.3 Height and Weight Menarche occurs after the initiation of the adolescent growth spurt and the attainment of the maximum rates of the growth in height and weight. (Frisch and Revelle 1970; Simmons and Greulich 1943) There are many general observations that girls at menarche are taller and heavier than those of the same age who have not achieved menarche (Tanner, 1962) In 1937 Richey separated the girls in his study into three groups according to whether their menarche was before the age 13, from 13.0 to 14.0 and after 14.

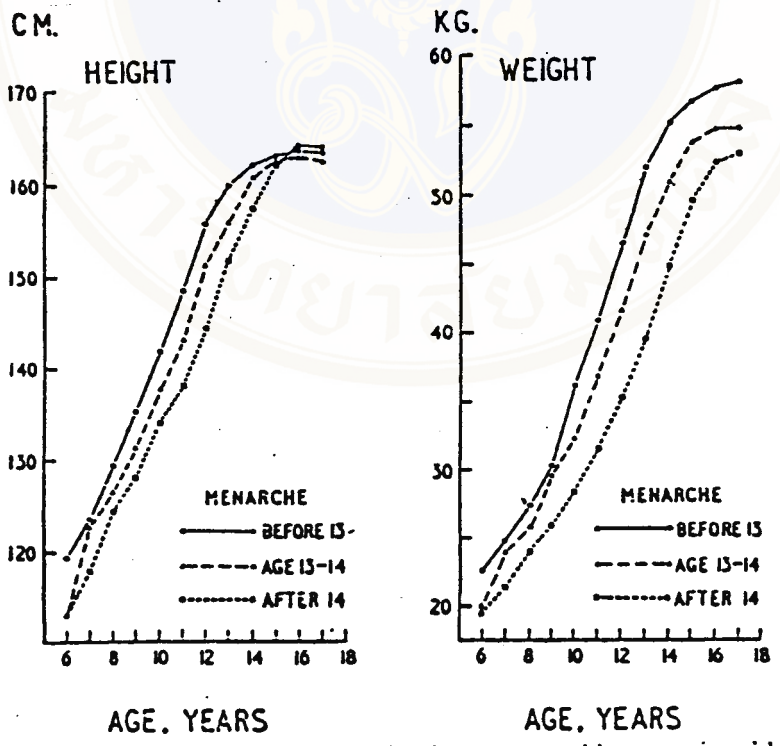

FIG. 3. Growth in height and weight of early, average, and late maturing girls. Distance curves. Mixed longitudinal data, redrawn from Richey (1937).

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In figure 3, redrawn from his data, the distance curves (i.e. actual amount attained at each birthday) are given for height and weight from age 6 to 17. The early menarche girls are greater in height and weight at age 6 and 7 and 8, before the influence of the spurt can make itself felt, they are large girls before puberty, both as regards height and weight. At maturity, however (age 17), there was no different in height between the three groups. The weight difference in favour of the early maturers, however, persists. Early-menarche are, not only people whose growth to maturity is advanced at all ages; they are also people who as adults have more weight-for-height than the late-menarche. (Simmons and Greulich, 1943; Richey, 1937)

Table 6 Mean age of menarche and mean height and mean weight at menarche and at age 18 for girls of CRC, BGS and HSPH growth studies grouped by age of menarche.

	At menarche				At 18 years old	
Age (yr)	No.	Mean age (yr)	Mean height (cm)	Mean weight (kg)	Mean height (cm)	Mean weight (kg)
Up to and incl. 11.9	35	11.4	156.4 ± .97	47.9 ± 1.1	165.9 ± 1.1	59.5 ± 1.5
12.0–12.9	60	12.4	158.0 ± .73	48.7 ± .95	165.8 ± .71	58.4 ± .99
13.0–13.9	54	13.4	159.1* ± 1.0	47.2 ± .93	165.2 ± .95	55.9 ± .89
14.0–14.9	32	14.5	160.9† ± 1.4	47.2 ± 1.2	165.8 ± 1.4	54.3‡ ± 1.4
All subjects	181	12.9 ± .09	158.5 ± .50	47.8 ± .51	165.6 ± .48	57.1 ± .57

* Difference from earliest group significant at $P < .05$. † Difference from earliest group significant at $P < .02$. ‡ Difference from earliest group significant at $P < .02$.

In 1971 Frisch and Revelle analyzed the adolescent growth spurt by determining the height and weight for each child at the age of initiation of the spurt in growth and at the time of maxium rate of growth using the data from three longitudinal growth studies, (from the growth data of the Child Research Council (CRC), the Harvard school of Public Health (HsPH),

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the data of the Berkley Guldance Study (BGS)) The three growth studies are comparable. Height and weight measurements from birth to age 18, collected in the years from 1929 to 1950, were given for half-yearly (CRS, RGS, HsPH upto age 11) and yearly (HsPH after age 11) intervals. The socioeconomic status of the parents was average (HsPH) and above average. (BGS and CRC) He concluded that at menarche, the mean weight of early and late menarcheal girls did not differ, whereas late menarcheal girls were significantly taller than girls with early menarche. At age 18, when growth in height had ceased for all girls, early and late menarcheal girls were of the same height but late menarcheal girls was lighter in weight and remained so into adulthood (shownin table 6)

Based on their findings of an unvarying mean weight at menarche, they proposed that there was a direct relation between body weight and menarche. A possible mechanism for such a relation was suggested by Kennedy and Mitra (1963) to explain their findings of the close relation of weight and first oestrus and mating in the rat. Their adaptation of this mechanism to explain menarche assumed that the attainment of the critical weight causes a change in metabolic rate, which, inturn, affects the hypothalamus-ovarian feedback by decreasing the sensitivity of the hypothalamus to oestrogen. The feedback is then reset at a level of gonadotrophins and gonadal hormones high enough to induce the ovarian and uterine maturation resulting in menarche.

Observations of earlier menarche are associated with attaining the critical weight more quickly: obese girls have menarche earlier than the average age (Donovan and van der Werff ten Bosch, 1965) Frisch (1972) reported an analysis of records of well-nourished and undernourished Alabaman white girls, using data reported previously by

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Dreizen et. al. (1967) Despite differences in nutritional status and in mean age at menarche between the two subgroups, the mean weight at menarche did not differ significantly.

Johnston et. al. (1971) compared Philadelphian white girls (mean menarcheal age = 12.62 ± 0.97 yrs) with upper class Guatemalan girls of mixed European and Mayan background (mean menarcheal age = 12.39 ± 0.88 yrs) The difference between the mean weights of 7.3 Kg. (16 lb) is statistically significant. This data showed that the concept of a critical body weight that cannot be applied to individuals has litlle meaning. If body weight is a "trigger", the values assigned to the trigger very so greatly among individuals that it is not a useful predictor. Also, significant differences exist among various samples. The mean menarcheal weight reported by Frisch (1972) for well-nourished Alabaman white girls is 44.6 Kg, with a standard deviation of 5.06 Kg. This is significantly less than the mean of Denver girls (47.3 Kg) ($t = 2.077$, $df = 104$, $P < 0.05$). Likewise, the mean weight of girls from the Melbourne growth study is significantly less than that of the Melbourne tall girls. ($t = 5.37$, $df = 105$, $P < 0.001$) Consequently, the hypothesis that there is an invariant mean weight at menarche must be rejected.

In 1972 Frisch and Revelle turned their attention to total body water (TBW) as a measurement of interest. In their study, they estimated the amount of body water for each subject from her height and weight, using the multipleregression equation of Mellits and Cheek (1970) ($TBW = -10.313 + 0.252\ (wt_{Kg}) + 0.154\ (ht_{cm})$ The estimated lean body mass (LBM) was calcolated from the estimated TBW, using the relationship $LBM_{Kg} = TBW_{liter}/0.72$. Analysis of these estimates

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for girls in the Berkeley, Denver and Harvard growth studies led to the following observation: (1) the mean estimated TBW and LBM at menarche are the same in early and late maturers, (2) the coefficients of variation of estimates of TBW and LBM at menarche are substantially less than the coefficients of variation of weight at menarche, and (3) the ratio TBW/weight at menarche is greater in late than in early maturers.

From the above it was concluded that, at menarche, early maturers are fatter than late maturers. The LBM was seen as the critical variable that triggered menarche because the mean LBM did not differ significantly between the two maturation groups. They considered LBM to be more critical than weight. The weight-height relation can be considered as an important standard of the nutritional status. So good nutritional status girls have earlier menarcheal age than poor nutritional status girls.

3.4 Percentage of body fat Frisch and McArthur (1974) indicated an even closer correlation between the start of menarche and body composition. The requirements put forward are that height must be completed, or nearly completed, and that fat must constitude an estimated 17% of body composition for menarche to occure. These authors consider that a body composition of about 22% of fat is needed for the maintainance of regular ovolatory periods.

Richardson et. al. (1977) studied menarche and growth on 415 urban and 405 rural black South African girls from the lower socioeconomic group. He reported that the mean percentage of body fat computed from foor skinfold (triceps, subscapular, supra-illiac and paraumbilical) in menstruating rural girls was 27.8% which was

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significantly greater ($P < 0.001$) than that of nonmenstruating girls, 23.3% - well above the 17% of Frisch and McArthur, indeed a little greater than the 22% required for regular ovulation. It is supported by the study of Richardson et. al. (1983). They studied a large interracial series of 4390 schoolgirls aged 6-17 years from 16 schools in South Africa. There were rural and urban black, coloured, Indian and white girls. They found all 8-year-old girls who had not had menarche as having a percentage of fat > 17%, but all except black rural and coloured girls of this age had a mean > 22%. Although we can not conclude that a body composition of about 17% of fat is the onset of puberty but we can say that early menarcheal girls have percentage of body fat more than late menarcheal girls.

There are many indeces of nutrition which have a direct relation to menarche. For example, height velocity, skeletal age, weight for height and percentage of body fat. In my study, I used weight for height to classify the nutritional status. Because height, weight and age at menarche are all interrelated. Early menarche is associated with smaller stature; likewise, stature and weight are correlated. If stature is uncontrolled statistically, the association between age and weight at menarche is obscured. I can't use height velocity and skeletal age because it has to be longitudinal study. There are also no regression equations for the prediction of body fat for using percentage of body fat.

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Table 7 Characteristics of the age at menarche, in years, of the Slovenian girls, according to the kind of nutrition

PROTEINOUS	MIXED	CARBOHYDRATIC
number = 45	number = 75	number = 103
$M \pm m_K = 12.65 \pm 0.133$	$M \pm m_K = 13.42 \pm 0.145$	$M \pm m_K = 14.1 \pm 0.111$
$\sigma \pm m_\sigma = 0.88 \pm 0.094$	$\sigma \pm m_\sigma = 1.25 \pm 0.104$	$\sigma \pm m_\sigma = 1.6 \pm 0.080$

3.5 Food consumption and food composition Nutrition markedly influences the age at menarche; proteinous food accelerates, while carbohydratic nutrition inhibits the process. As shown by Kraljčerček (1956) the age at menarche depends on the type of nutrition, the 223 girls from northeastern Slovenia and the 52 from the island of Susak were classified according to their nutrition into the following groups: proteinous, mixed and carbohydratic. Among 223 girls, 45 ate proteinous, 75 mixed, and 103 predominantly carbohydratic food. The characteristics in table 7 show that the girls who ate predominantly proteinous food had their menarche sooner than girls who ate mixed food, whereas those who ate carbohydratic food menstruated the lastest. (P-value < 0.0001) By using the same method of investigation, similar results (table 8) were obtained for 52 girls of the island of Susak.

Table 8 Characteristics of the age at menarche, in years, of the Susak girls according to the kind of nutrition

PROTEINOUS	MIXED	CARBOHYDRATIC
number = 10	number = 17	number = 25
$M \pm m_K = 12.9 \pm 0.237$	$M \pm m_K = 14.1 \pm 0.297$	$M \pm m_K = 14,2 \pm 0,237$
$\sigma \pm m_\sigma = 0.73 \pm 0.163$	$\sigma \pm m_\sigma = 1.22 \pm 0.208$	$\sigma \pm m_\sigma = 1.15 \pm 0,163$

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The result are in accordance with Škerlj's assumption, that proteinous food has an influence on earlier menarche. (Skerlj, 1943 classified the girls according to the weekly and daily frequencies of meat eaten)

Dreizen et. al. (1967) reported that a longitudinal study of 30 undernourished and 30 well-nourished girls from early childhood to early adulthood confirms that chronic undernutrition retards skeletal growth and maturation, postpones menarche, and extends the length of the growth period.

Richardson et. al. (1983) studied a large inter-racial series of 4390 school girls aged 6-17 years from 16 schools. There were 1067 rural and 1092 urban black, 760 coloured, 695 Indian and 776 white girls. The respective ages when 50% of girls were menstruating, were, rural 14.6 and urban black 13.6, coloured 12.9 Indian 12.4 and white girls 12.4 years. There was differences in food consumption patterns within groups ranging from the monotonous carbohydrate diet with low fat intakes, of the black groups, to the varied diets with high fat intakes, of white pupils. They reported resulting of percentage energy as follow:

Carbohydrates. Black groups derived the bulk of their energy from this source namely, 77% in rural and 68% in urban areas; coloured and indian 57 and 58% respectively, and whites 51%

Fat. White children had the highest percentage energy intake from fat namely 38%. In coloured and Indian children intakes were lower, 31 and 32% respectively, and in black groups, urban and rural 13%. Non-white groups derived approximately double the energy from

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animal compared with vegetable fat sources and white about equal amounts.

Protein. Black rural and urban, also coloured groups, derived 10-11% of their energy from protein, while for white and indian groups the value was 11-12%. The animal protein intake was approximately two to three times as much from vegetable as from animal sources for the Black groups, about equal in coloured and indian and higher from animal sources in white groups.

Food consumptions which have influence on earlier menarche are proteinous food and the highest percentage energy intake from fat. In my studies, I am only interested in proteinous food that may influences the menarcheal age. And I think there are not differences in percentage energy intakes from the same nationality. I used proteinous food as the index of food consumption.

4. Socio-economic factor Socio-economic status has probably some effect on the menarche age; thus it has been shown that children of the higher socio-economic strata tend to atlain puberty earlier than those from the lower socio-economic group. Also, the nutritional status of girls, which is in turn telated to socio-economic status. It is impossible to discuss socio-economic position adequatety without reference to the nutrition of the girls because the former largely determines the latler.

Israel. (1959) found that girls from homes with an income of Rs 500 and over per month menstruated 6 months earlier (13.0 years) than girls from families whose monthly income was below Rs 150. Kamat and Kamat (1959) also found that menarche for girls in their low income group was at 13.4 years while it was at 13.1 years for girls in

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their high income group. They did not, however, consider these differences to be significant. Madhaven (1965) also noted that "children of higher socio-economic strata tend to attain puberty earlier than those from lower socio-economic groups". He collected the data in Indian girls between the ages of 11 and 18 years in both urban and rural areas of Madras and Kerala States. Fifty-five to seventy per cent of the urban girls belonged to the category 'high' and about 90 per cent of the rural sample to the 'low' socio-economic group. The mean age at menarche for urban girls were found to be lower than those of rural girls in both the state. This might indicate the influence of socio-economic status on the age at menarche.

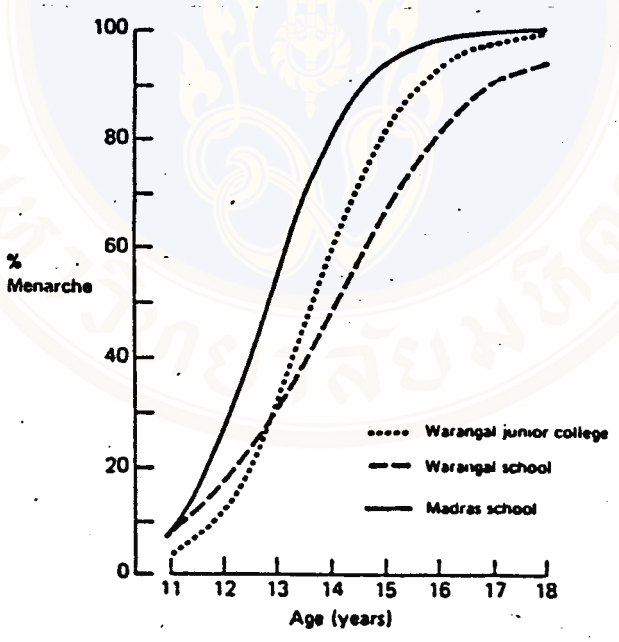

Figure 4: Menarcheal age in the three Indian schools.

It is supported by Roberts et. al. (1977). They studied menarche age in samples of Indian girls in three schools. School I and school II (Warangal junior college and Warangal school) are both in Warangal in Andhra Pradesh. This part of Andhra is not well developed, and the population remains generally of low socio-economic

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status. The Warangal school children are poorer than those in the junior college. By contrast pupils in school III (Madras school) are from the richer socio-economic stratum of society. School III showed a median age at menarche (12.86) nearly a year ahead of that (13.74) of the girls in school I ($P < 0.001$). The slopes for these two school do not differ significantly. School II on the other hand not only shows a significantly later median age (14.08) than the other two but it also shows a significantly lower slope, indicating that it takes this population longer for all to attain menarche. The curve fitted are shown in figure 4.

Table 9 Median ages of menarche (probit estimates) from different areas of Mexico.

	n	Md.	S.D.	S.E.	χ^2	df
Oaxaca: Rural and Urban Colonia[a]	315	14.27	1.69	0.20	2.41	3
Tampico-Altamira: Rural[b]	212	13.79	1.64	0.20	3.09	3
Villa de Xochimilco, D.F.:Urban[c]	670	12.76	1.22	0.07	4.21	4
Mexico City, D.F.; Urban[b]	400	12.75	1.32	0.10	2.02	2
Merida: Urban[d]	993	12.61	1.44	0.08	52.79*	6
Tampico: Urban[b]	416	12.55	1.28	0.10	2.90	3

a Present study; b Pena Gomez (1970); c Diaz de Mathman et al. (1968 a); d Diaz Bolio (1967).

*$P < 0.01$.

Malina et. al. (1977) collected menarcheal information in May 1972 from 315 Mestizo school girls 9-16 years of age in an urban colonia and in two rural communities. The colonia is a suburban

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development on the slopes of the hills south-west of the city of Oaxaca de Juarez. Median income for the colonia is low. The families of the girls surveyed could be generally considered as the poor, labouring class. The girls surveyed in each community did not systematically differ in the pencentage which had attained menarche at each age; and the heights and weights of the children in the three communities did not consistently differ. So data from the three communities were combined for analysis. The means of menarcheal age are compared to those for girls from different areas of Mexico (table 9) The mixed urban-rural sample of Oaxaca girls attains menarche later than the rural girls from Tampico and Altamira on the eastern coast of Mexico by about one-half year. In contrast, both of these samples are significantly delayed in menarche relative to urban girls from Mexico City, Villa de Xochimilco, Merida and Tampico. (the χ^2 values indicated a good fit in the probits) It should be noted that health and nutritional circumstances in the state of Oaxaca are among the poorest in Mexico. The height and weight data shown in figure 5 suggest that Oaxaca children are living under nutritional circumstances that are poorer than those of the other sample. This is evident in the lower average height and especially lower average weights.

Laska et. al. (1982) studied the menarcheal age in 5546 Warsaw girls and 7771 rural girls from seven regions of Poland and collected information on the number of children in families and father's educational level. The material was analysed in four groups by education-level of fathers: primary, vocational, secondary and university education. In the rural population the largest group had only primary education but the largest group in the Warsaw population had secondary

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and University education. They found that the mean menarcheal age of Warsaw girls was 12.73 ± 0.03 years, while that of rural girls was 13.40 ± 0.02 years. They concluded that the factors responsible for the delayed maturation of rural girls, as compared to the urban population, are the lower education level of the rural population and the higher number of children in their families.

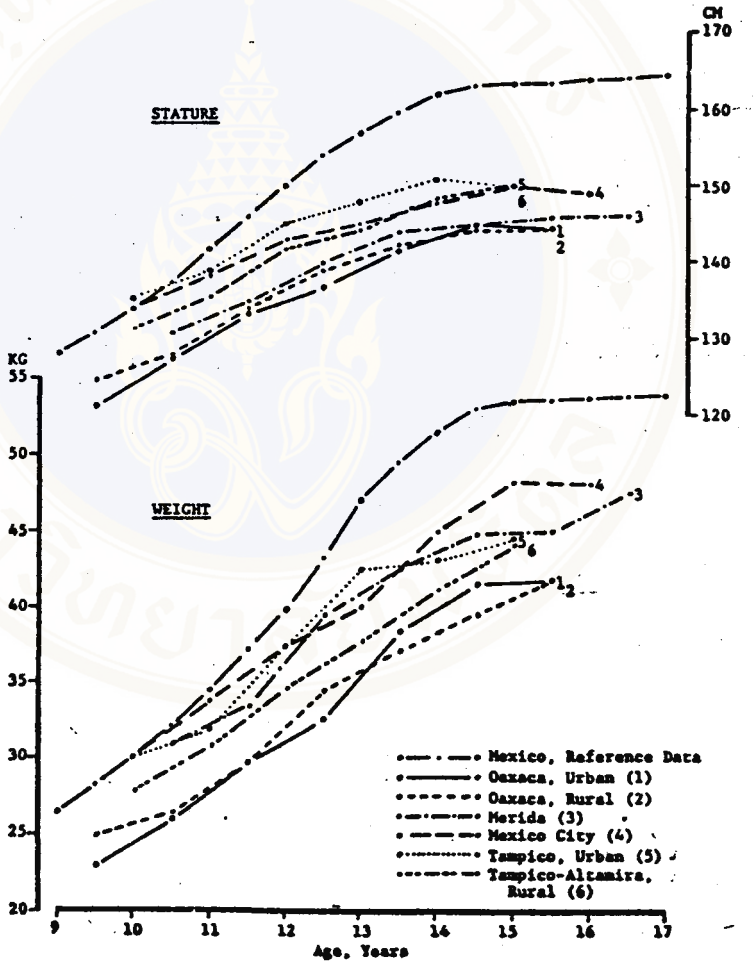

Fig 5 Heights and weights of girls included in menarche surveys relative to reference data for Mexico. See text for sources of the data.

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Table 10 Menarcheal age in the three sub-groups of Sudanese girls in Khartoum (probit analysis).

Group	Social class	Mean family size	No.	Mean ± S.E. (years)	S.D.	χ^{2+}	d.f.
Group A	High	4.6	335	13.35 ± 0.15	1.32	6.3	18
Group B	Middle	5.5	636	13.85 ± 0.14	1.36	18.2	19
Group C	Low	5.8	401	14.06 ± 0.18	1.38	20.3	15
Pooled			1372	13.91 ± 0.07			

+None of the χ^2 values is significant at the 5% level indicating a good fit.

Atlallah et. al. (1983) presented the results of a study of the age at menarche in three different social classes in Khartoum according to the locality of the schools as high, moderate and low as follows:

Group A: high-class residential area; parents mostly senior professionals

Group B: middle-class residential area; parents mostly work as civil servants or skilled labourers.

Group C: low-income residential are; parents mostly work in temporary unskilled labouring jobs.

The girls were all Sudanese, their age ranging between 8 and 18 years. The results show in table 10. It lists the statistics of the age at menarche. The chi-aquare test for goodness of fit was not significant for any group studied, indicating good fits. Well off girls in group A menstruate at age 13.35 ± 0.15, earlier by 0.5 years than middle

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class girls in group B, who have a mean menarcheal age of 13.85 ± 0.14 ($P < 0.05$). Girls in group C have a mean menarcheal age of 14.06 ± 0.18, which is not significantly different from that for group B. This may be due to the fact that poorer classes tend to spend most of their income on food consumption and thus the differences in the dietary pattern between B and C is not very great. Between groups A and C there is a significant difference of 0.71 of a year ($P < 0.001$). The mean family size was found to differ, the poorest and the unemployed having the highest average number in the family. (4.6 in group A, 5.5 in group B and 5.8 in group C) These differences in family size, especially among the poorer classes, represent a direct enviromental effect, concealed poverty, acting through nutrition and standards of care.

From the literatures reviewed, There are many variables indicated, socio-economic starus, e.g. family income, father's education, father's occupation, family size etc. In my individual study A, it was found that the girls with a higher luncheon allowance had an average lower menarcheal age statistically. So in this study, per capita income and daily luncheon allowance were the two variables expected as reliable predictions of socio-economic status.

5. Physical exertion factor Studies of twins (monozygotic and dizygotic) and of mothers and daughters indicate a significant genetic component in the timing of menarche. On the other hand, envoromental sources of variation in the timing of this maturational event are just as significant and include, for example, nutritional status, family size, socioeconomic background, certain disease states and so on.

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More recently, intensive physical training has been suggested as a factor which may delay menarche. Three reports (Frisch et. al. 1981, Orosz, Ciora and Mormurache 1972, Sidhu and Grewal 1980) indicate later mean ages at menarche among athletes who began training before menarche than among those who began training after menarche, suggesting perhaps that training before menarche delays this maturational event.

Malina (1983) suggested that an association between delayed menarche and age at entry into sport. Swimmers who tend to have an earlier menarche than other athletes, and gymnasts, figure skaters and ballet dancers, who have a later menarche tend to begin formal training during childhood, i.e., these are early-entry sports. Thus the age at entry into regular sport training is important.

Volkov et. al. (1974) working with young Soviet swimmers, conclude that moderate training (eight to ten hours per week) is associated with the earliest menarche, while very intensive training (16 to 18 hours per week) is associated with delayed menarche.

Table 1| Characteristics of 89 Ballet Dancers Reporting Lack of Menstrual Cycles, Irregular Cycles, and Regular Cycles.*

Group Classification (No. in Group)	Age at Time of Study	Age at Menarche	Age at Start of Training	Height	Weight	Estimated TW/BW†
	yr	*yr*	*yr*	*cm (in)*	*kg (lb)*	*%*
Primary amenorrhea — age > 16 (9)	18.4±0.5	Not yet	8.4±0.9	163.7±1.3 (64.4±0.5)	43.5±0.5 ‡ (95.7±1.1)	59.5±0.6‖
No menarche yet — age < 16 (11)	14.3±0.4	Not yet	6.7±0.5	158.7±1.2 (62.5±0.5)	42.0±0.9 §¶ (92.4±2.0)	58.9±0.4‖
Secondary amenorrhea (13)	17.9±0.4	14.3±0.4 ‡	7.8±0.4	162.7±1.4 (64.1±0.6)	44.9±1.6 (98.8±3.5)	58.3±0.7‖
Irregular cycles (27)	16.7±0.3	13.9±0.3 ‡‖	7.2±0.7	163.5±0.9 (64.4±0.4)	45.9±0.7 (101.0±1.5)	57.7±0.4‖
Regular cycles (29)	17.0±0.4	13.3±0.2 ‖	7.4±0.4	162.0±1.0 (63.8±0.4)	47.0±0.8 (103.4±1.8)	56.3±0.5
All subjects (89)	16.8±0.2		7.4±0.3	162.3±0.5 (63.9±0.2)	45.5±0.5 (100.1±1.1)	57.6±0.3

*Values are expressed as mean ±S.E.M. †Total body water expressed as percentage of body weight. Fat/body weight per cent = 100 − (per cent water / 0.72)

‡Significantly different from group with regular cycles, $P<0.05$. §Significantly different from group with regular cycles, P<0.5

¶Significantly different from group with irregular cycles, $P<0.01$ ‖Age for one subject was not known

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Frisch et. al. (1980) reported on 89 young ballet dancers at three professional ballet schools in highly competitive programs. They distributed a questionnaire on age, height, weight, duration of training, age of menarche and menstrual periodicity to 89 dancers. The data are sumarized in table 9. Ten per cent (nine) of the group reported primary amenorrhea occuring at 18.4 ± 0.5 years (mean ± S.E.M.). Twelve per cent (11) of the dancers reported they had not undergone menarche at 14.3 ± 0.4 years. Fifteen per cent (13) of the group reported secondary amenonhea, and 30 per cent (27) reported irregular cycles. Thirty three per cent (29) of the dancers reported regular cycles. The mean age at menarche reported by the postmenarcheal dancers was 13.7 ± 0.01 years which is significantly later ($P < 0.001$) than the mean ages of 12.8 ± 0.05 years reported for American girls. Dancers with amenarrhea and with irregular cycles were significantly leaner than dancers reporting regular cycles (as is indicated by their average total body water as per cent of body weight in table 11) Klaos (1941) discussed the possible influence of sports training on the timing of menarche. He concluded that the physique difference between the sport students and others was the more important factor. Using Kretschmer's physique classification scheme, the physiques of sports students (N = 124) were distributed as follows: 51.7% leptosomic (linear), 31.0% athletic, and 17.3% pyknic (lateral). Hence, the sample of sports students had a greater percentage of linear physiques and a smaller percentage of lateral physiques. Linear physiques are generally associated with later maturation, while lateral physiques are associated with earlier maturation.

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Table 12 Frequencies of Not Having Reached Menarche and of Having Regular Menstrual Cycles, According to Age Group and Quetelet index.

Age group	Frequency*				
	14-15	16-17	18-19	20-22	23-30
10-14 yr					
Not reached menarche	92	70	46	24	19
	(44/48)	(138/198)	(94/204)	(46/193)	(8/42)
Irregular cycles	75	42	33	29	18
	(3/4)	(25/60)	(36/110)	(42/147)	(6/34)
	15-17	18-19	20-22	23-25	26-35
15-19 yr					
Not reached menarche	7	2	1	1	0
	(2/28)	(2/130)	(2/256)	(1/100)	(0/25)
Irregular cycles	27	23	13	20	12
	(7/26)	(29/128)	(32/254)	(20/99)	(3/25)

*Expressed as a percentage figures in italics denote the Quetelet index, and those in parentheses denote numbers of subjects.

Vandenbroucke and Valkenburg (1981) They wished to report additional evidence about the association among excessive thinness, delayed menarche and irregular menstrual cycles. In the age groups that were of interest to the study of menarche 10 to 14 years old and 15 to 19 years old 685 girls in the first group and 539 in the second provided analyzable records. They classified these girls into five categories, according to Quetelet index (weight in Kilograms divided by the square of the height in meters). The five categories

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more or less corresponded to qualitative judgments of the subjects as thin, lean, normal, stout, or obese. The results are presented in table 12. The associations between menarche, irregularity and the Quetelet index persisted according to two year age groups. They concluded that thiness delayed menarche, and irregular cycles.

Table 13 Proportions of girls aged 10-14 who had reached menarche according to whether they were thin and indulged in intensive sports activity

	%	SE*	Proportion
Thin:			
Intensive sport	15	±3.4	16/109
No intensive sport	37	±4.3	47/126
Not thin:			
Intensive sport	47	±4.4	60/129
No intensive sport	75	±2.6	214/284

*SE = Standard error.

Vandenbroucke et. al. (1982) classified 648 girls aged 10-14 years. (the same group that had studied) as being thin or not thin on the basis of the body mass index. (weight in Kg/(height in meter)^2, thinness was defined as a body mass index of 17 or smaller) and whether or not they engaged in intensive sports activity was established. In all four combinations of these categories they counted the number of girls who had reached menarche at the time of the survey. The table 13 shows the results. The presence of either thinness or intensive sports activity was associated with roughly a twofold

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decrease in the proportion of girls who had reached menarche. When both factors were present the decrease was about fourfold.

The suggested mechanism for the association between intensive physical training and delayed menarche is hormonal. It is suggested that intensive training and perhaps associated energy drain influences circulating level of gonadotrophic and ovarian hormones and in turn menarche. Exercise is also a highly effective means of stressing the hypothalamic-pituitary axis.

Diet has slso been postulated. High training loads and relatively inadequate nutrition might result in an energy drain and in ture function of delay menarche. Dietary inadequacy may influence athletes in different sports differentially. Swimmers, for example, tend to have a larger body mass (and muscle mass) than gymnasts, figure skaters and ballet dancers, so that an energy deficiency might not influence them in the same way as it may influence the smaller athleles. The physique requirements (i.e., selection) and dietary demands (i.e., weight control) of gymnasts, figure skaters and ballet dancers might contribute uniquely to the delay of menarche in these athletes.

In this study, I don't consider the physical exertion factor because of the regular sport training of the samples. (intensive training is associated with delayed menarche).

6.. Geographic factors In the sense in which it is used here, is the effects of actual geographic factors, That is temperature and humidity, altitude, light and season.

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Temperature and humidity Recent research has not supported the belief, once widely held, that sexual development occurs at an earlier age in the tropics than in temperature zones. In facts, there is now almost unanimous agreement that climate in inself has litlle or no effect on menarche.

Kennedy (1933) reported that menarche occurs at the same age in Edinburgh, Rome and South Russia, places in which both temperature and humidity differ markedly. The mean menarcheal age of 14.22 ± 1.00 years reported by Ellis (1950) for girls in Lagos, Nigeria, differs very little from that specified in Levine's study (1953) of Alaskan Eskimos (14.42 ± 1.20 years) Israel (1959) noted that the mean menarcheal age in Indian women (13.59 ± 1.48 years) was not significantly difference from that reported for European and American women. Wilson and Sutherland (1953) found similar mean menarcheal age in the hot, humid areas of Central India (14.65 ± 1.55 years) and the hot, dry regions of Northern Nigeria (14.65 ± 1.24 years)

Altitude Valsik et. al. (1963) reported that elevation above sea level influences menarcheal age at the rate of approximately three month's delay for each 100 meters of altitude. They studied the sexual maturation of daughters of farming families residing at different altitudes in the mountains of northwest Slovakia and found that girls living at the highest altitudes had a significantly later menarche (14.9 years) than those living at the lowest elevations (14.2 years) As the authors pointed out, the economic and nutritional conditions at high altitudes are poorer, and the caloric requirements for existence may be greater.

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Light The possibility that light influences human sexual naturation has not received much attention. Zacharias and Wurtman (1964) compared two populations of blind girls (one born prematurely and the other at full-term) with two comparable nonblind groups and found that in both groups of blind girls, the age at menarche was lower than that in the nonblind groups. When blindness was compounded by a total loss of light perception, menarche occurred even earlier.

Season Few studies have been made of the relation between season and the event of menarche, and the findings which have not been consistent are as follow:

In 1923 Bolk obtained data on menarche from 2000 Dutch girls, and found that the highest monthly incidence of menarche (10.3 per cent) occurred between May and August; another smaller peak (8.5 per cent per month) occurred in December and January; very few girls started to menstruate in February or October.

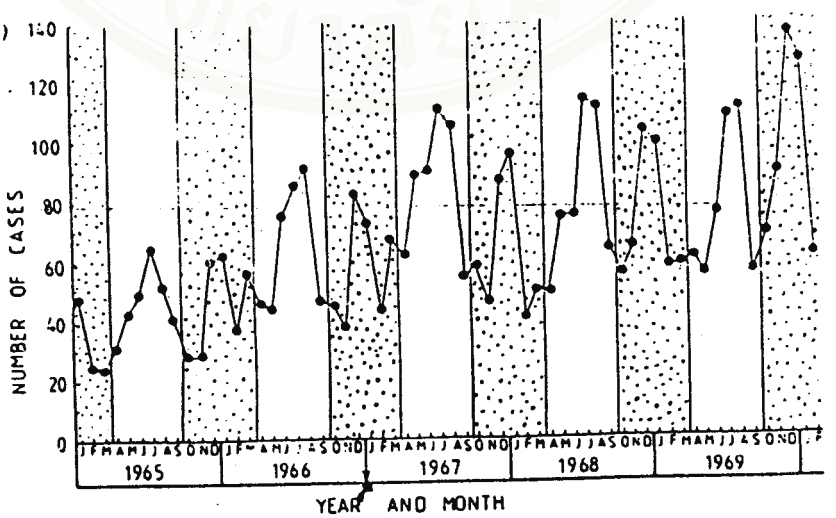

Fig 6 The number of girls in our sample who reached menarche in each month between January 1965 and February 1970.

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Reymert and Jost (1947) studied 261 girls residing in a settlement in Mooseheart, Illinois; they too observed that menarche was more likely to occure in summer or winter than in fall or spring. In recently Brundtland and Liestol(1982) studied 11000 girls aged 10-18 years in Oslo, Narway. Retrospective data collected from school children to study the monthly variations from 1965 to early 1970. The results show that the menarcheal incidence varied according to a stable bimodal seasonal pattern with peak in December - January and July - August. (fig 6) This pattern corresponds to those observed in Sweden and Finland. (Bergsten Brucefors 1974, Kanter and Widnolm 1971, see figlure 8 (a))

On the other hand, Matsumoto et. al. (1963) found that among 10,000 Japanese girls, the incidence of the menarche was greatest in the spring and summer and lower in the fall and winter. Shakir (1974) studied the seasons and years of the first menstrual period of 5000 girls aged 13-18 years, attending normal school in Baghdad. They belonged to a rather homogeneous population. Of the 5000 girls investigated, 203 (4.1%) were not sure of the time of the event, and 407 (8.1%) had not started their menses. Of the 4390 girls who remembered either the month or the season of their first menses. 1935 had started them less than 3 years (Group 1) and 2755 more than three years ago (Group 2) when classified according to the age at which they started their first menses, 1224 girls had started before the age of 13 years (Group 3) and 3166 after the age of 13 years. (Group 4) The data show a highly significant seasonal rhythm of menarche in all the groups, with the peak in summer (July) and lowest extreme in winter (December) and autumn (November)

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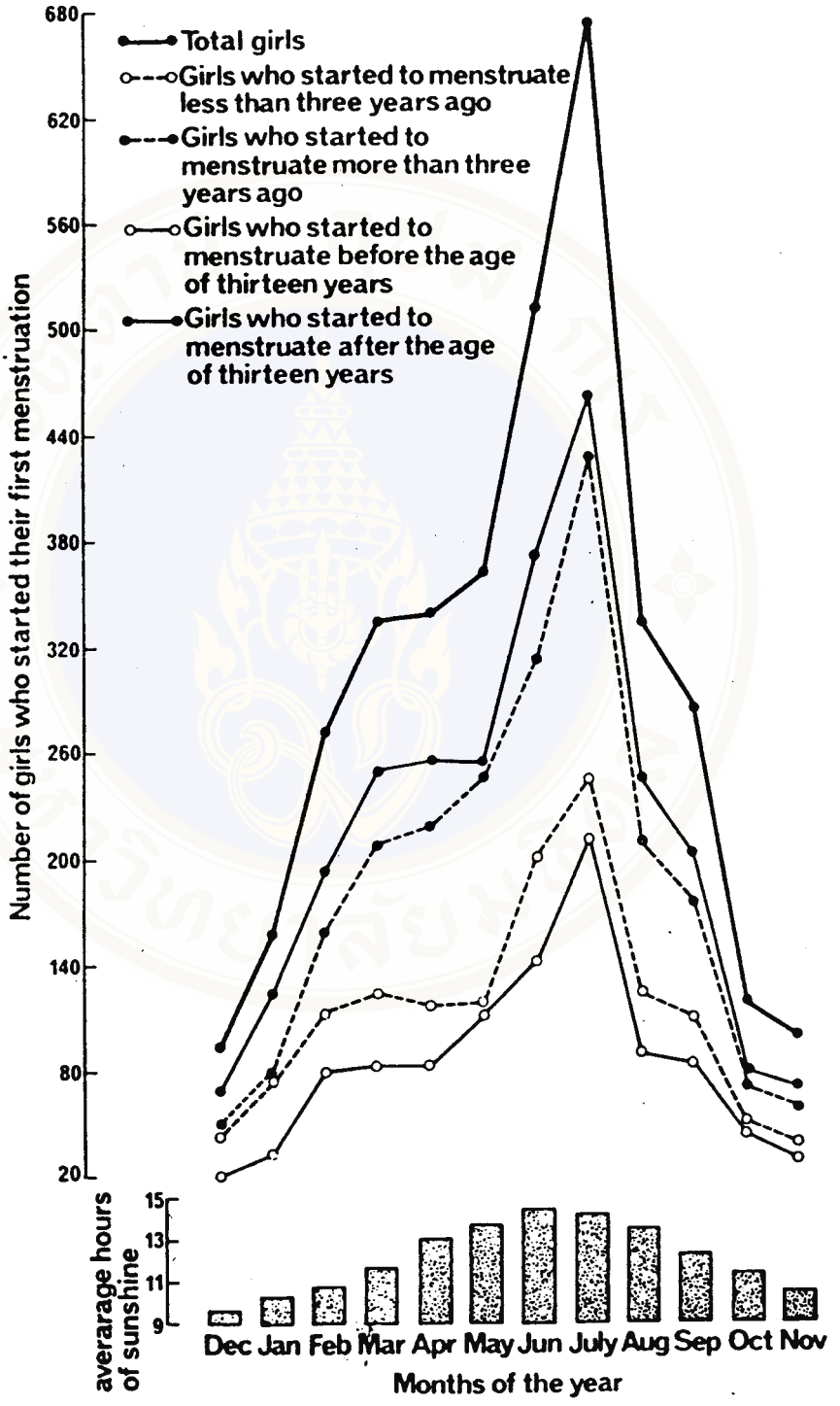
Fig 7 MONTHLY RHYTHM OF THE INCIDENCE OF MENARCHE IN GIRLS ATTENDING SCHOOLS IN BAGHDAD



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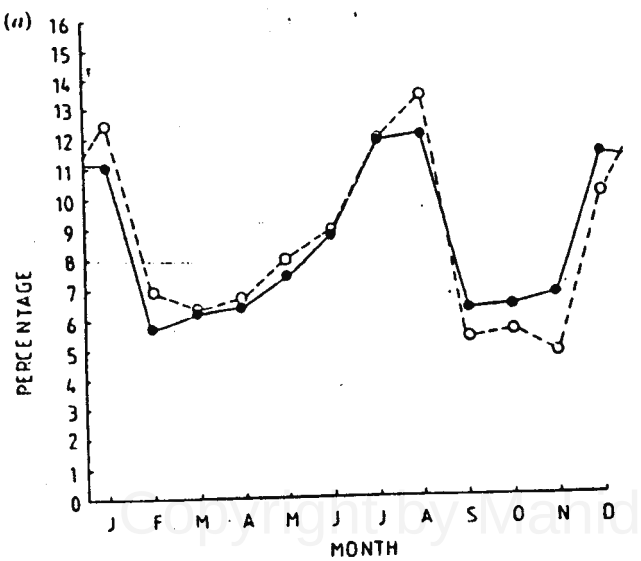
This rhythm was the same, irrespective of whether girls had their first menses recently or not, and whether they were early or late-maturers. These findings were different from those of Engle and Shelesnyak (1934), in their study of 250 girls in a New York City orphanage, found that the incidence of menarche was fairly constant during autumn (25 per cent) winter (30 per cent), and spring (25 per cent) but dropped to 18 per cent in the summer. And from those of Bojlén and Bentzon (1971) who investigated the development of puberty in Copenhagen schoolgirls, during the period 1948 to 1955, prospective data on menarche were collected for 2288 schoolgirls and recollected menarcheal age data for 1492 schoolgirls whose menarche had occured prior to the investigation. The monthly distribution of the prospective data showed a maximum in January, a minimum in February - March, and then a rise to December, only interrupted by a fall in August - September (Fig 8 (b)) This finding is in agreement with that of Grimm (1952) who reported data on menarche in 896 girls from Halle/ Saale and 1989 girls from Berlin. In both groups menarche is most frequent during the winter months, particularly in July, in the Berlin girls in occured in February to May (Fig 8 (b)



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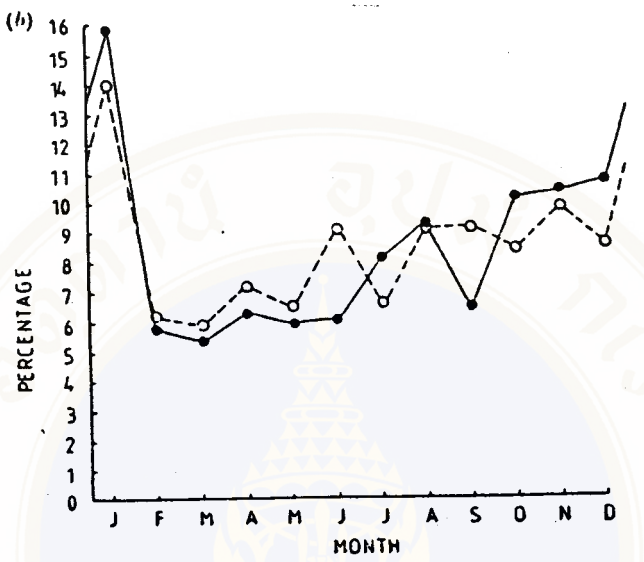

Figure 8 Seasonal variations in menarche in different geographical areas.
(a) Filled circles: data from Oslo. Open circles: data from towns in Sweden (from Bergsten-Brucefors 1974).
(b) Filled circles: data from Copenhagen (from Bojlen and Bentzon 1971). Open circles: data from Berlin and Halle (from Grimm 1952).

If menarche does indeed occur more frequently in one time of the year than another, it is possible that the effect of season is mediated by the annual cycle of changing length of daylight, but it has not recieved much attention. Non it appears surprising that the causes of these seasonal variations remain unrevealed.

This study is a comparative study between two area in the same region and almost the at the same time. So there are hardly any seasonal, temperature and altitudinal differences which would indicate geographic factors.

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7. Psycho-social influences The psycho-social factor is poorly understood, and its influence has been disputed; Brown (1966), for example, arguing in favor and Tanner (1966, 1967) against. Damon et. al. (1969) demonstrate that growth and maturation accelerate independently should direct attention to psycho-social of the environment.

Urbanization is one feature of the environment that has increased steadity since the secular trend in age at menarche has been observed. In developing country, where ways of life still differ greatly in city and country, urban girls begin to menstruate earlier than rural girls, while both urban and rural girls show the secular advance (Tanner, 1968). In the United Kingdom and Holland, however, where urbanization has progressed to the point where little difference remains between urban and rural environments, urban and rural girls are said not to differ in age at menarche. (Tanner) "Urbanization increases crowding, stimulation—sensory, social, and intellectual—, competition, and "stress".

Damon et. al. (1969) reported that the effect of "urbanization" on age at menarche may be analogous to the changes in wild rats brought about by domestication in the laboratory environment (Richter, 1959). Among other differences, sex glands develop earlier in the laboratory rat than in the wild rat. There are many examples of marked biological changes in man over short periods of time, in the form of the epidemic increase during the present century of "diseases of civilization", such as coronary heart disease (Eptein, 1965) and peptic ulcer (Damon and Polednak 1967; Susser, 1967) For both diseases, animal experiments as well as epidemiological observations on man implicate psycho-social factors among others.

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In short, psycho-social factors cannot be dismissed in the present state of the factors influenceing of menarcheal age. In this study psycho-social factors is the main focus by comparing urban and rural environment.

Conclusion

Menarche is the important condition in the sexual life of the female. It has implications in the biology of reproduction and gynaecological health. Very little is known at present about why the process of maturation starts, when it does and then why it proceeds at its specific pace. Experimental studies may eventually clarify the processes responsible for sexual maturation. However, unit such knowledge is available, clinicians and other students of human biology must use information derived from the technics of the study of natural history to determine the extent to which an individual girl's sexual maturation depends upon her genes and her enviroment. This study attempts to summarize the available information concerning the factors that cause menarche. Factors that may influence the menarcheal age.

1. The Hereditary factor It seems that fundamentally the control of the menarche age is genetical. Age at menarche does have a genetic basis, as shown by studies of sisters (Boas, 1932; Reymert and Jost, 1947), twins (Petri, 1935; Tisserand. Perrier, 1953), and mothers and daughters (Bolk, 1926; Gould and Gould, 1932)

2. Environmental factors The attainment of a functional reproductive system in females, of which a menstrual period is but one component, is a complex physiological and behavioral process involving

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changing hypothalamic sensitivity, altered hormonal output. Girls begin to have physical manifestations of the changes in ovarian function that are associated with environment. The environmental factors (such as nutrition, socio-economic status, activities, stress and sexual stimulation from urbanization) can affect the menarche by stimulating the central nervous systems (CNS) to effect hypothalamus. It causes the pituitary gland to release the hormones responsible for ovulation and menstruation. (shown in figure 9)

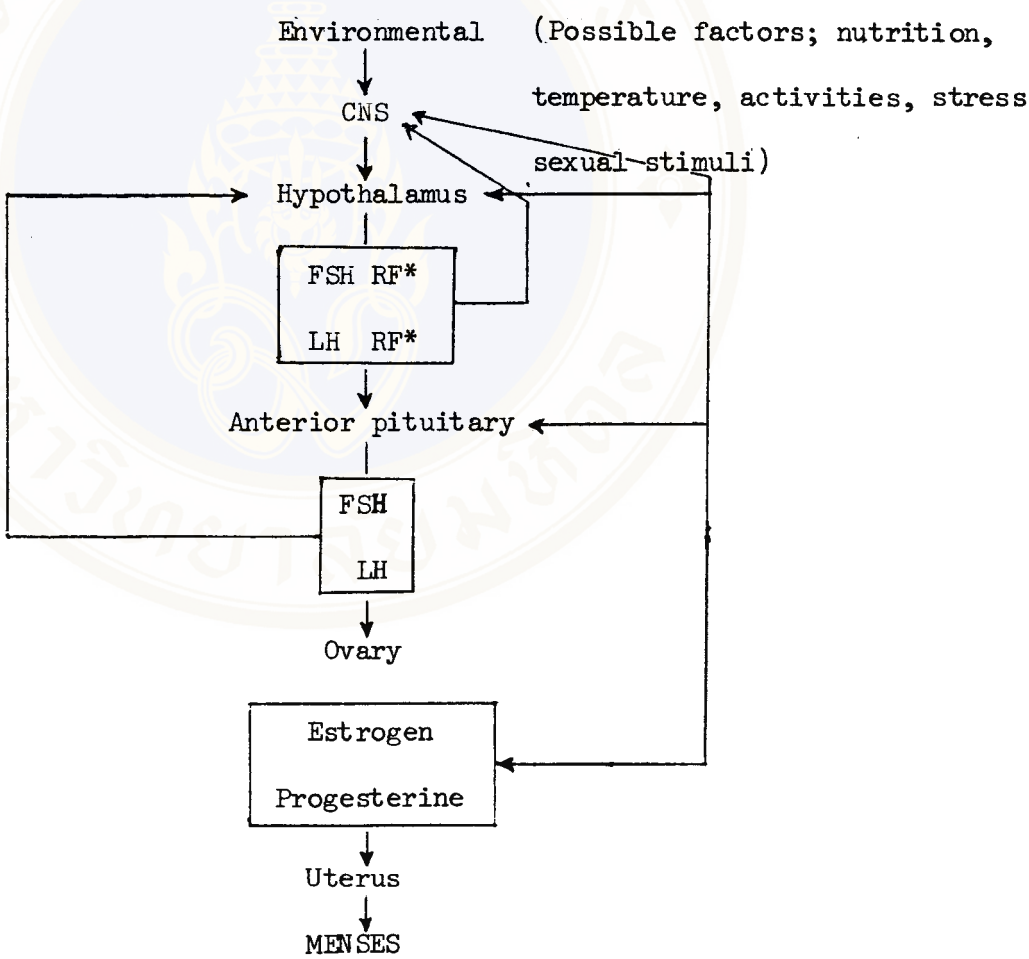

Figure 9 Interrelationships and Feedback Mechanisms Relating to the Human Menstrual Cycle

Source; Contraceptive technology 1978-1979. 9th Revised Edition, P, 30.

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Many of the enviromental factors are in fact inter-related, and their effects on maturation cannot be examined separately. I have attempted to point out inter-relation where relevant. Studies performed in many regiouns of the world have shown that an acceleration of physical growth and sexual maturation follows a major improvement in socio-economic conditions. Socio-economic level is related to many factors, such as diseases, activities, food intake, food quality and urban-rural living where there are differences from psychosocial. Diseases, activities and food intake are related to the nutritional status which influences the menarcheal age. Food quality which is related to food intake also influences the menarcheal age. (shown in figure 10)

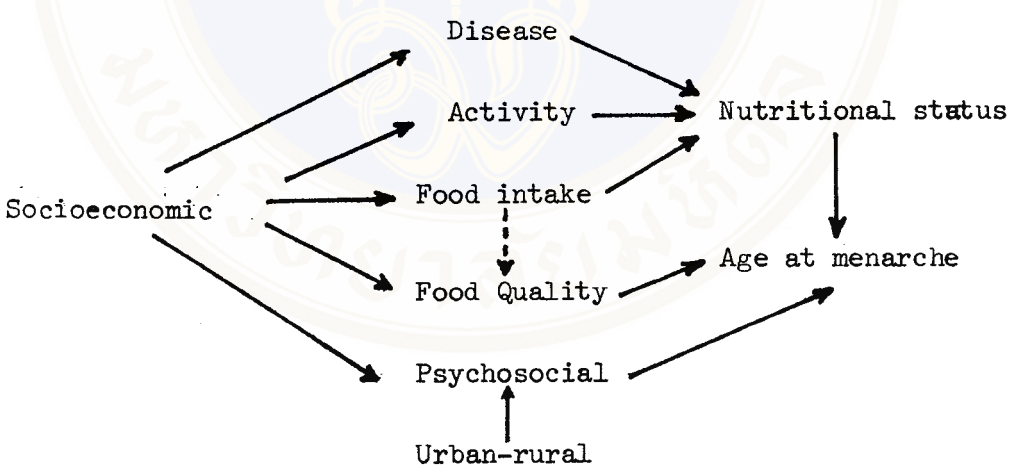

Fig 10 Interrelationships of factors influencing age at menarche

This study is interested in the important factors that may influence the menarcheal age. While controlling diseases and activities factors. The interesting factors are

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1. The nutritional status (by using weight and height as variables)
2. The socio-economic status (by using per capita income and daily luncheon allowances as variables)
3. The food quality (by using protein comsumption diet as variable)
4. The urban-rural environments (by using place of birth as variable)

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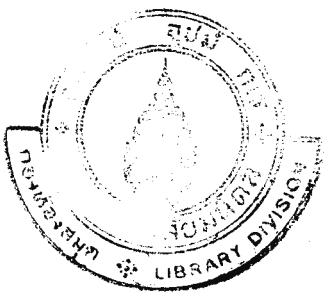
CHAPTER III

Materials and methods.



I The studied subjects

The population in this study were schoolgirls 10- 16 years of age from public schools in Bangkok and Nakornnayok. Those in Bangkok were schoolgirls from Matayom Wat Thatthong and Wat-Thatthong school. Those in Nakornnayok were schoolgirls from Wat-Thong, Wat-Chong, Vung-Sai, Pa-ka Pi-Kul and Ban-na Noyokpitayagorn school. The following criteria were used in selecting the population.

1. Age between 10 - 16 years
2. Thai nationality
3. apparently healthy and without history of chronic diseases such as bronchial asthma, G.I. tract disorders , mental disorders etc.
4. Natives of Bangkok and Nakornnayok.
5. Regular sport training

Any one of these schoolgirls who attained their menarche during June 15th to November 30th 1985 automatically becomes our study subject.

II Data Collection

The girls who had not had menarche were informed about the purpose of the study and asked to enter this study by reporting the date of their first menstruation to their teacher or their class repre-

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sentative. The examiner then collected the data from these subjects within 2 weeks of their first date of menatruation. The Data were collected from the subjects who met the above criteria by using the following step : -

1. Anthropsmetric measurements.

Anthropometric measurement were administered for each subject of the first menstruation. These measurements include :

1.1 Weight A computer bathroom scales was used for the collection of weight. The reading was made to the nearest of 0.2 kilogram. During the assessment subjects were requested to remove their shoes then stood on the center of the weighing scales.

1.2 Height The height was measured by using wooden height board or height measurement that had already been standardized . The reading was made to the nearest of 0.5 centimeter. During the measurement all subjects were requested to take their shoes off and stood erect on the plate or the floor, firmly against the vertical backboard with their chin pararell to the horizontal level and eyes forward.

1.3 Left-mid arm circumference A metal tape was used to determine the mid arm circumference. The measurement was made at the marked midpoint of the acromion to the olecranon process of the subject's lelt hand,while the subject's arm hung loosely by her side. The examiner took the measurement without compressing the circumference and the reading was made to the nearest 0.1 centimeter. (see Appendix D)

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1.4 Tricep skinfold thickness Tricep skinfold thickness was determined by using Harpenden Calipers. During the measurement the subject stood on platform, relaxed. The examiner, with the thumb and four finger of the left hand standing behind the subject, grasped the dorsal skinfold pararell to the long axis over the triceps muscle of the subject's left arm. Allowing the skinfold to slide free of muscle, the examiner gently applied the caliper on the skinfold, and the measurement was read to the nearest 0.1 milimeter. (see Appendix D)

2. Interviewing :

The following data were obtained by interviewing, using a designed questionaire

- Age, menarcheal age (the age is counted to the nearest month with one additional month whenever the number of days is over 15)
- Parent's education and occupation, number of siblings in the family
- Per capita income, luncheon allowance
- Frequency of protein consumption pattern.
- Psychosocial characteristics such as watching television, watching movies, reading magazine dating etc(see Appendix B)

3. Food consumption

Information about the subject's food consumption were measured by using 3 - days dietary record and 24 hour dietary recalled for 3 days by the examiner. Each subject was taught how to record her food intake on the record-sheet (see Appendix C) Colour photographs of foods were given to confirm their record. On each recording day, the examiner would recall this record of all the days. The Data obtained were converted into total calories, gm and percent of carbohydrate, gm and percent of protein and gm and percent of fat as total calories.

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III Material and instruments

1. Tanita Computer bathroom scales. (The reading is nearest of 100 gms)
2. Wooden height-board.
3. Harpenden calipers
4. Tape
5. Designed questionaire
6. Record-sheet
7. Color photographs of foods

IV Data processing

After the information was collected, it was analyzed by using the SPSS computer package on the SPSS version H. Release 8.1.

V. Data Analysis

Four statistical methods were used during this study:

a. the X^2 - test : 1 for testing of normality before deciding whether to use parametric or nonparametric tests. If they were normally distributed then parametric statistics would be selected.

: 2 for testing of homogeneity between the 2 groups (Bangkok and Ban-na) about sample characteristics such as number of offsprings in the family, parent's occupation, parent's education and psychosocial characteristics.

b. the t-test : for comparing the mean menarcheal age between the two groups according to the hypothetical factors.

c. the F - test for ANOVA to determine the significant difference of the sample means. In this study one way classification was used which showed interaction effected of place of birth, nutritional factor, socio-economic factor and protein comsumption of samples upon mean menarcheal age.

d. Correlation coefficient : for establishing the association between the independent variables.

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CHAPTER IV

RESULTS

One hundred and twenty-seven schoolgirls who experienced their first menstrual period within the six months of data collection were the study subjects and divided into 2 groups according to their birth place. Sixty-seven schoolgirls were from Bangkok and 60 from Ban-na.

The data of these girls were analyzed and presented in two parts. The first part is about their general characteristics and the second one is about the association of hypothetical causal factors and menarcheal age. Table 14 presents the total number of girls under observation in both groups classified by age, the number and percentages of those who fall naturally into the study subjects group. In Bangkok, there are 67 schoolgirls (12.96%) and 60 schoolgrils (13.27 %) in Ban-na, who attained menarche during the data collection period.

Table 15 and figure 11 presents the number and percentage of menstruating girls in both groups classified by menarcheal age. For those whose menarcheal age is between 11 years and 11 years 11 months, they would be in the 11-12 years age group. For those whose menarcheal age is between 12 years and 12 years 11 months, they would be in the 12-13 years age group and so on. The majorily of girls in both areas experienced between the ages of menarche 12-14 years. The χ^2 - test for normality is found that there are normal distribution for both groups. (χ^2 = 2.27, df = 3, P-value = 0.52 for Bangkok, χ^2 = 2.35, df = 3, P-value = 0.50 for Ban-na).

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Table 14 Total number and percentage of the girls classified by the age of menarche

Age group (yr)	Bangkok			Ban-Na		
	Total number of girls	Girls menstruating number	% of age group	Total number of girls	Girls menstruating number	% of age group
10 - 11	27	5	18.52	65	2	3.08
11 - 12	110	10	9.09	118	6	5.08
12 - 13	186	25	13.44	131	24	18.32
13 - 14	150	19	12.67	101	19	18.81
14 - 15	36	7	19.44	30	6	20.00
15 - 16	8	1	12.50	7	3	42.85
Total	517	67	12.96	452	60	13.27

Table 15 Number and percentage of menstruating girls in Bangkok and Ban-Na according to menarcheal age.

Menarcheal age (yr)	Bangkok		Ban-Na	
	N	%	N	%
10 - 11	4	5.97	2	3.33
11 - 12	10	14.93	5	8.33
12 - 13	25	37.31	21	35.00
13 - 14	19	28.36	23	38.34
14 - 15	7	10.45	8	13.33
15 - 16	2	2.98	1	1.67
Total	67	100.00	60	100.00

Normality test $\chi^2 = 2.27$, df = 3, P-value = 0.52, $\chi^2 = 2.35$, df=3, P-value=0.50

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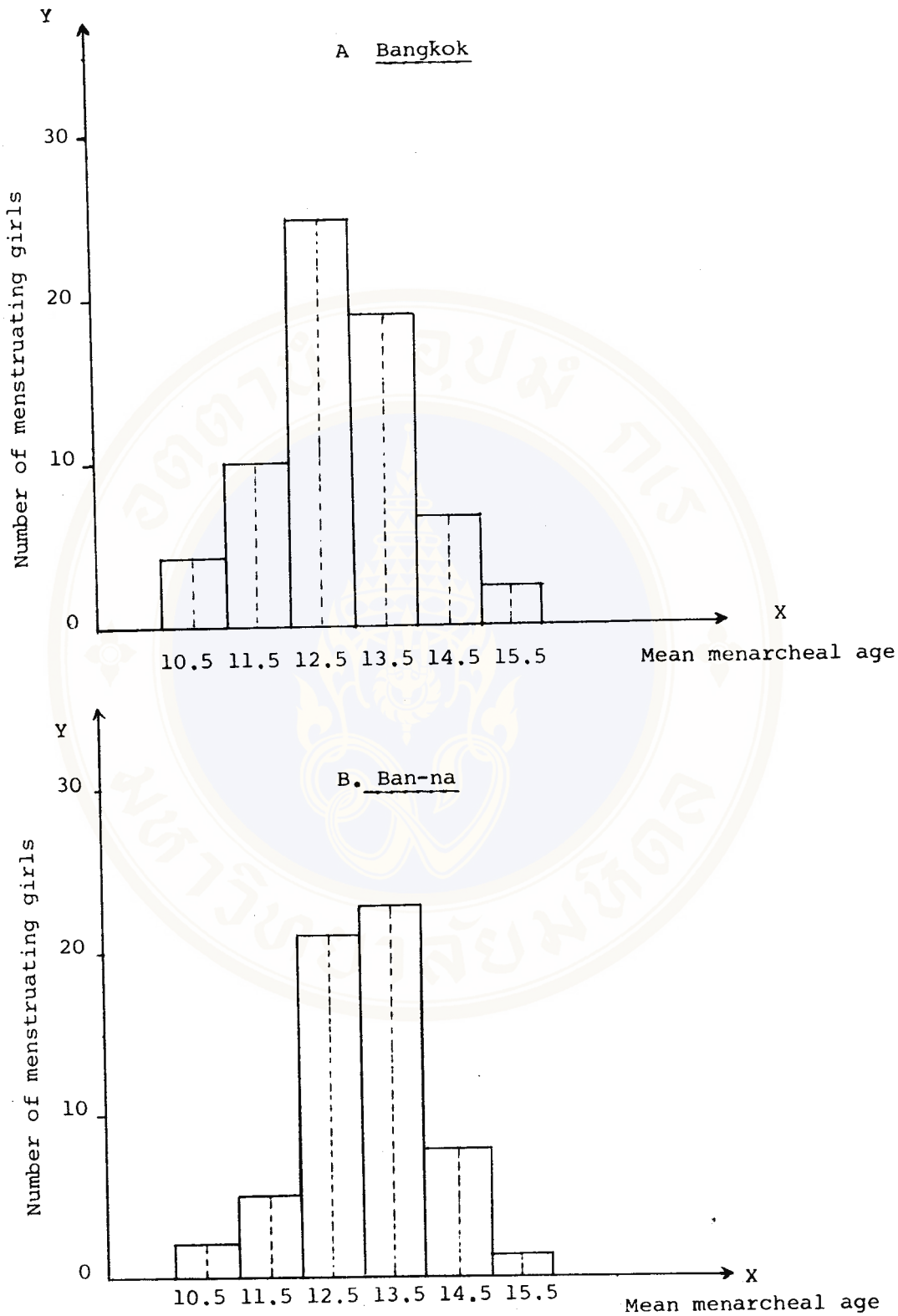

Figll The frequency of menstruating girls in relation to mean menarcheal age.

A = Bangkok

B = Ban-na

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General Characteristics of the Study Samples

General Characteristics of the study samples : are presented in table 16-18.

1. The subjects' family background

1.1 Number of siblings in the family

Table 16 and figure 12 presents the number of siblings in the subjects' families. The majority of the subjects have 3-4 siblings in the family in both groups (Bangkok = 52.23%, Ban-na = 46.67%). The χ^2-test for homogeneity shows no significant difference between the number of siblings in the family of both groups (χ^2 = 1.22, df = 4, P-value > 0.75).

1.2 Parent's occupation

The majority of the fathers' occupations in Bangkok are Skilled labourers (59.70%) and merchants (22.38%) while those in Ban-na are agriculturalists (33.33%) and government officers (21.67%). The χ^2- test for homogeneity of the father's occupation shows significant differences between the 2 groups (χ^2 = 37.96, df = 3, P-value < 0.0005). And there are also significant differences between the mothers' occupations (χ^2 = 36.96%, df = 4, P-value < 0.0005) (shown in table 17 and figure 13).

However it could not be concluded which group had better occupations because of the differences of environmental situations.

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Table 16 Number and percentage distribution by number of siblings in the family

Number of Siblings in the family	Bangkok		Ban-Na		χ^2	df	P-value
	number	%	number	%			
1 - 2	17	25.37	16	26.67			
3 - 4	35	52.23	28	46.67			
5 - 6	8	11.94	11	18.33	1.22	4	>0.75
7 - 8	4	5.97	3	5.00			
> 8	3	4.47	2	3.33			
Total	67	100.00	60	100.00			

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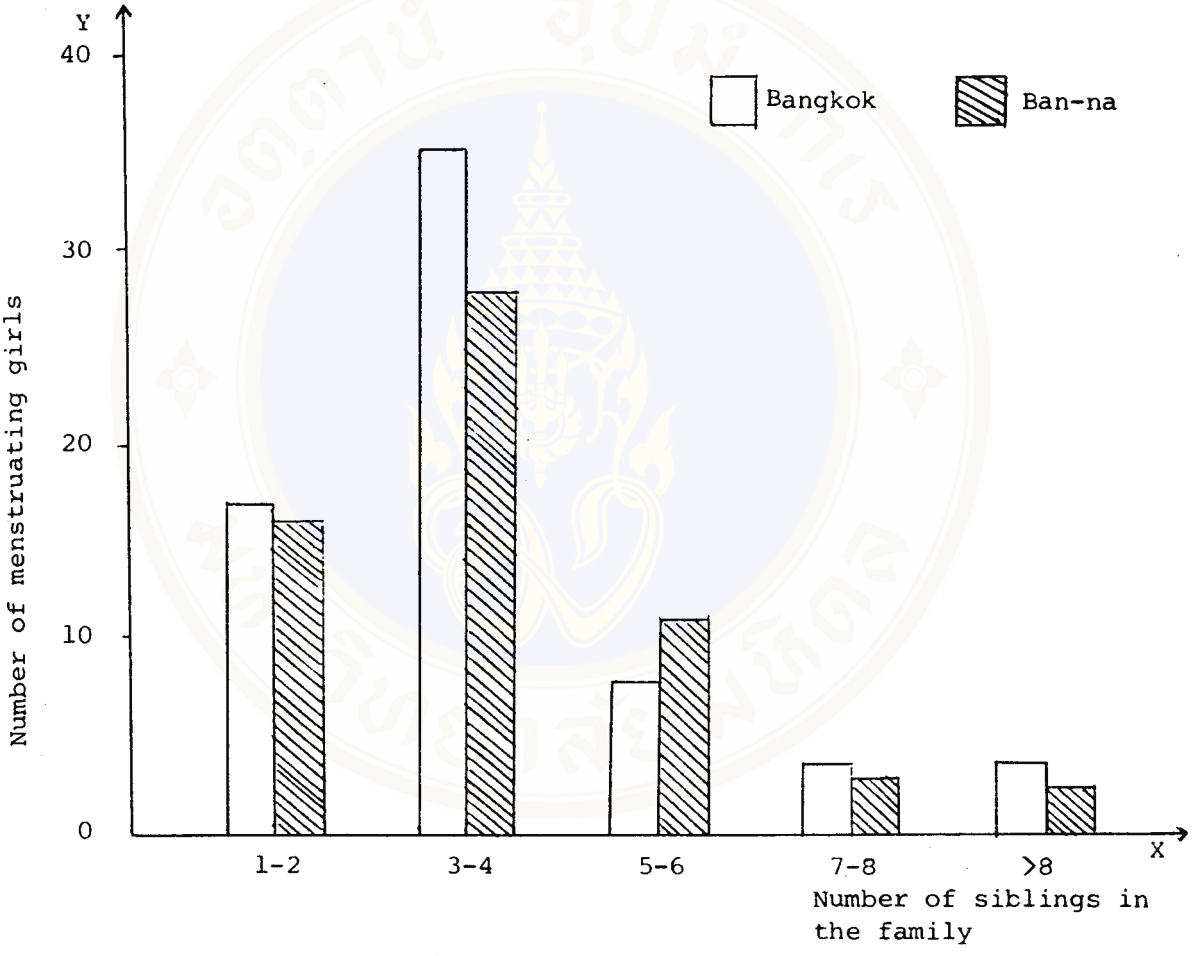

Fig.12 The frequency of menstruating girls distribution by number of siblings in the family.

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Table 17 Number and percentage distribution by parent's occupation

Parent's occupation	Bangkok		Ban-Na		χ^2	df	P-value
	number	%	number	%			
Father's occupation							
Government official	5	7.46	13	21.67			
Merchant	15	22.38	10	16.67			
Skilled labourer	40	59.70	11	12.33	37.96*	3	<0.0005
Unskilled labourer	-	-	2	3.33			
Agriculturalist	1	1.49	20	33.33			
Unknown+ dead	6	8.95	4	6.67			
Total	67	100.00	60	100.00			
Mother's occupation							
Government official	1	1.49	5	8.33			
Merchant	26	38.81	10	16.67			
Skilled labourer	21	31.34	7	11.67			
Unskilled labourer	-	-	2	3.33	36.96*	4	<0.0005
Agriculturalist	-	-	21	35.00			
Housewife	18	26.87	13	21.67			
Unknown+ dead	1	1.49	2	3.33			
Total	67	100.00	60	100.00			

*significant at P-value < 0.0005

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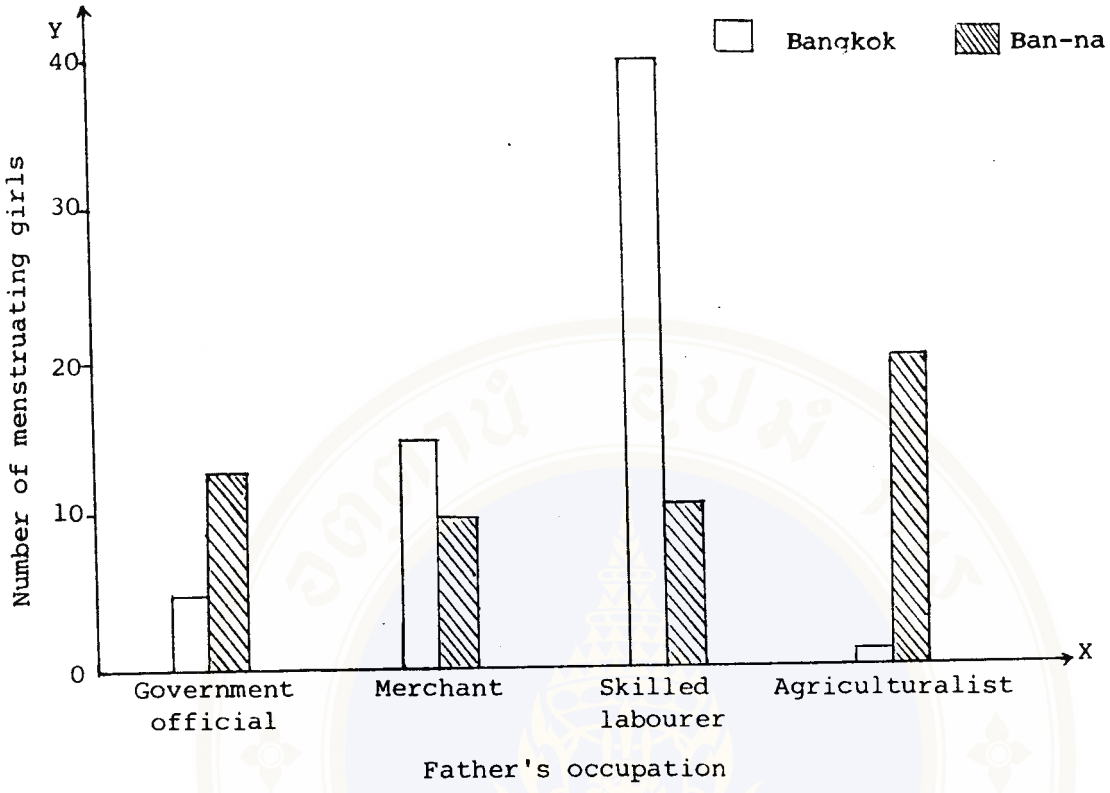

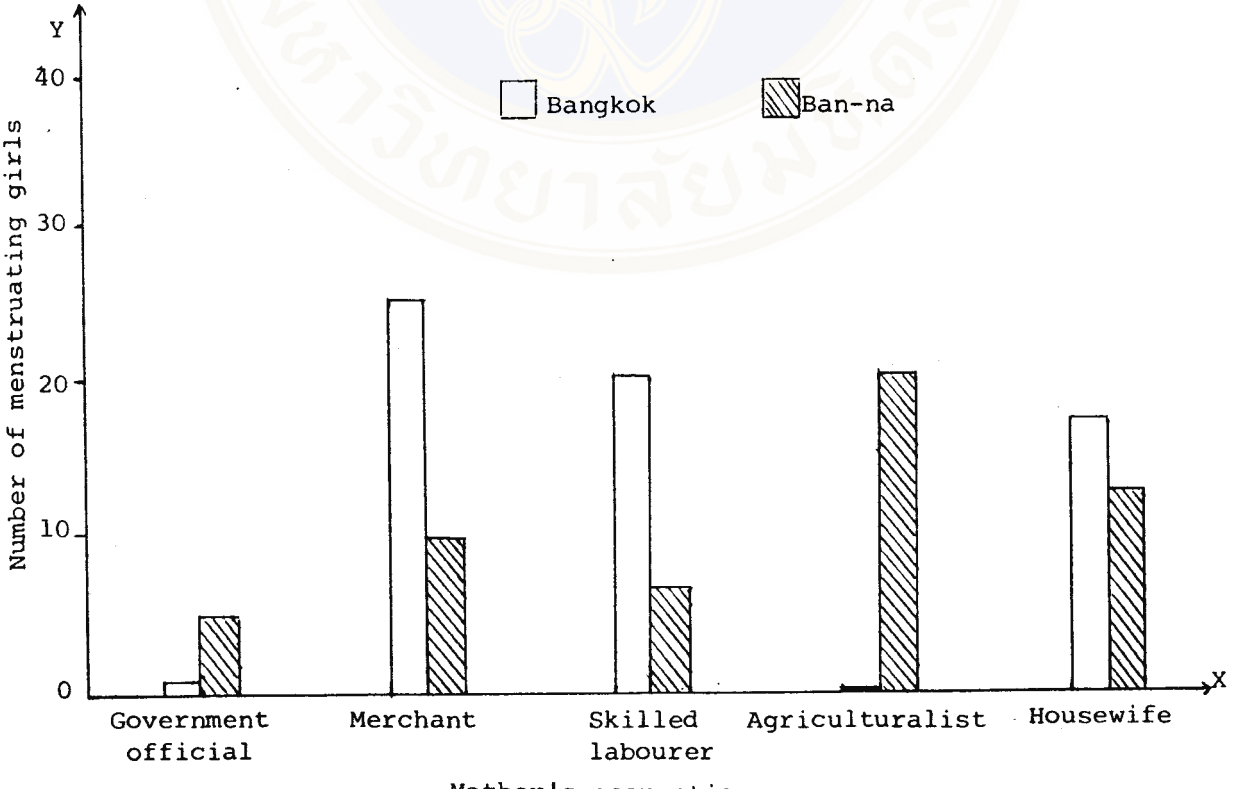

Fig.13 the frequency of menstruating girls distribution by parent's occupation

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1.3 Parent's education

Table 18 and figure 14 shows that the majority of the fathers' educational attainment in Bangkok are to primary school (50.75%) and secondary school (28.36%)level. Only 1.49% are higher than secondary school while the fathers in Ban-na are 13.13%. From percentage distribution of fathers' education in table 18, fathers in Ban-na seem to be better educated. The χ^2- test for homogeneity of fathers' education isa significant difference between the 2 groups. ($\chi^2 = 9.39$, df = 3, P-value < 0.05). But there is not a significant difference between the mothers' education ($\chi^2 = 3.37$, df = 3, P-value > 0.25).

From three variables, one could say that both groups belong to the same socio-economical level or the samples in Ban-na showed a higher socio-economical level than Bangkok.

2. Psychosocial characteristics

The comparison of psychosocial characteristics that derived from the environmental factor are presented as Follows :

2.1 Roller skating

The majority of subjects in Bangkok and Ban-na have never roller skated (86.57% in Bangkok, 96.67% in Ban-na) The χ^2 test for homogeneity is not a significant difference between both groups ($\chi^2 = 2.41$, df = 1, P-value > 0.10).

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Table 18 Number and percentage distribution by parent's education

Parent's education	Bangkok		Ban-Na		χ^2	df	P-value
	number	%	number	%			
Father's education							
under primary school	8	11.94	3	5.00			
Primary school	24	50.75	37	61.67			
Secondary school	19	28.36	12	20.00	9.39*	3	<0.05
Vocational training	1	1.49	6	10.00			
College or University	-	-	2	3.33			
Unknown	5	7.46	-	-			
Total	67	100.00	60	100.00			
Mother's education							
Under primary school	14	20.90	6	10.00			
Primary school	44	65.67	43	71.66	3.37	3	>0.25
Secondary school	5	7.46	7	11.67			
Vocational training	2	2.99	3	5.00			
College or University	1	1.49	1	1.67			
Unknown	1	1.49	-	-			
Total	67	100.00	60	100.00			

*significant at P-value < 0.05

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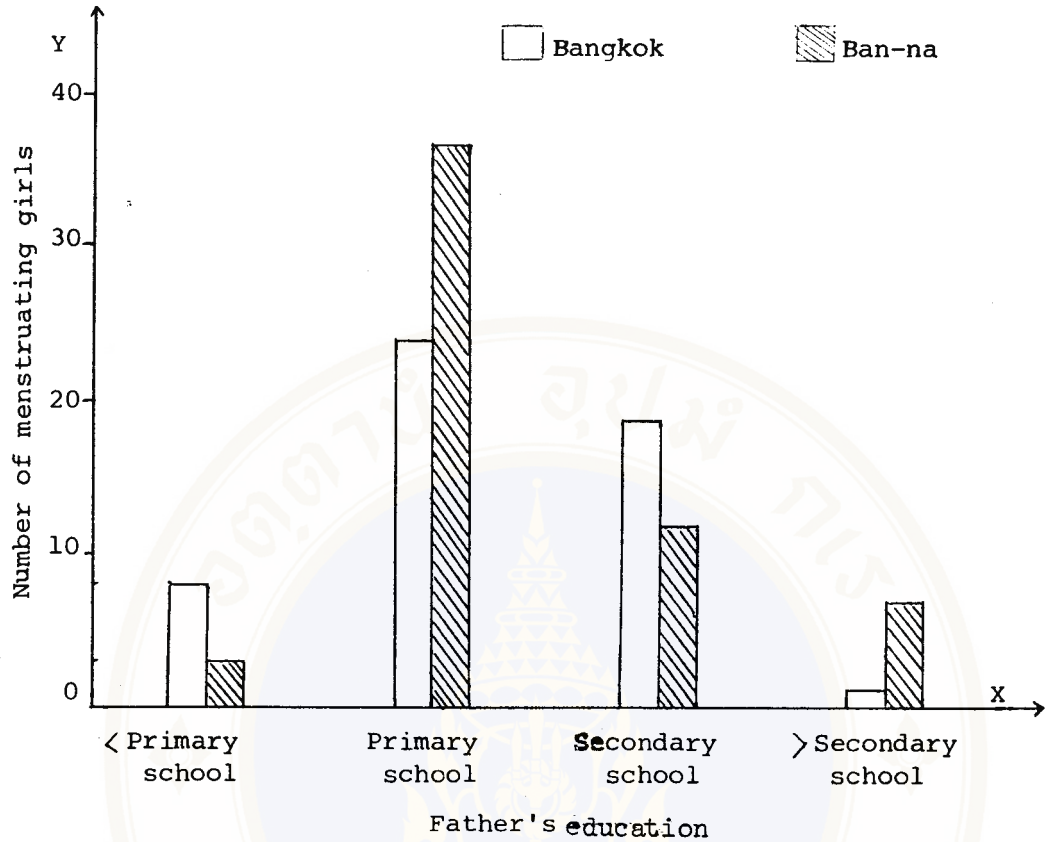

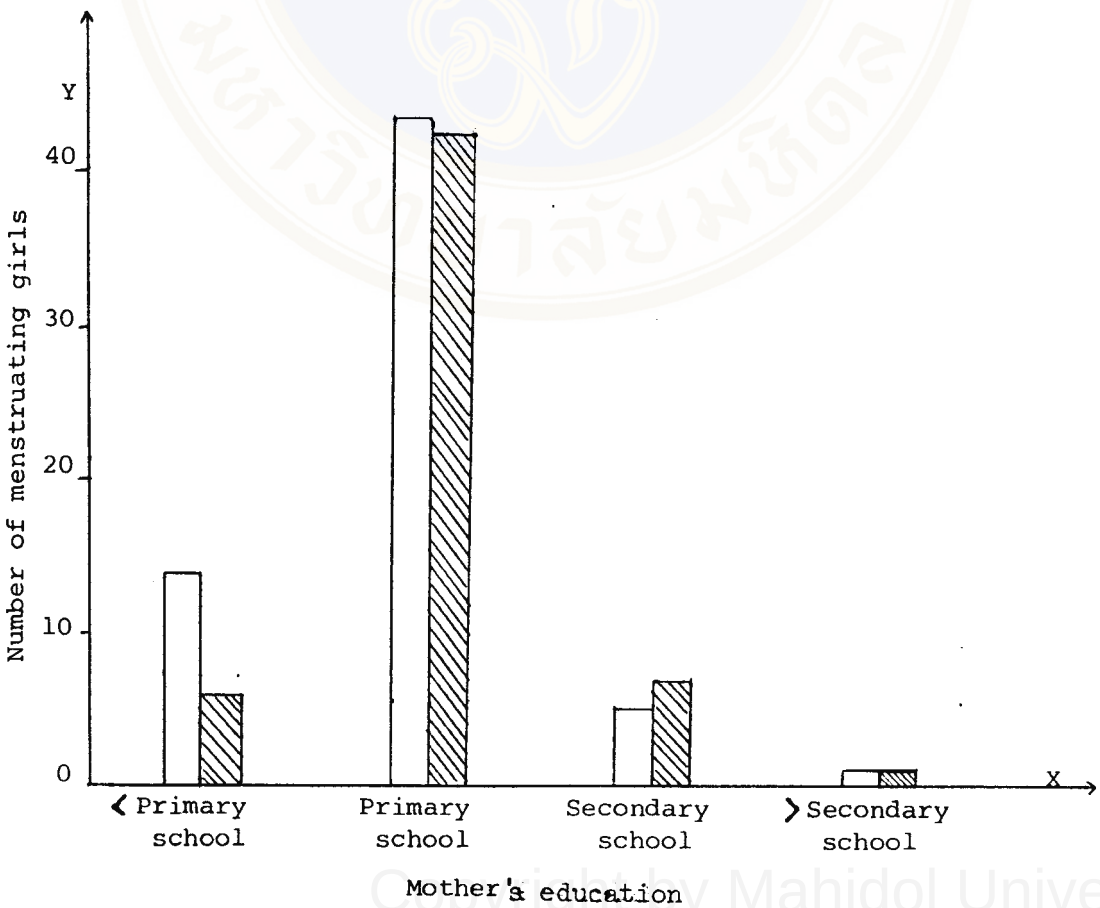

Fig.14 The frequency of menstruating girls distribution by parent's education

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2.2 Attendance at disco-theques

None of the subjects in Bangkok and Ban-na had ever been to a disco-theque.

2.3 Dating

None of the subjects in either group had ever dated.

2.4 Frequency of going to movies

The majority of subjects in Bangkok have never been a movie (65.67%) while 76.67% in Ban-na had never been. The χ^2- test for homogeneity isnot a significant difference between both groups (χ^2 = 2.6, df = 3, P-value > 0.25).

2.5 Preferred magazine Reading

The majority of subjects in Bangkok prefer to read cartoon+ movie star magazines (29.85%) or cartoon+ movie star+ fiction magazines (28.26%). While in Ban-na most of the subjects prefer to read cartoon magazines (31.67%) or cartoon+ movie star magazines (26.67%). There is not a significant difference between the 2 groups (χ^2 = 9.5, df = 6, P-value > 0.10)

2.6 Frequency of television watching

Most of the subjects in Bangkok and Ban-na watch television everyday (86.56% in Bangkok, 75% in Ban-na). 10.45% in Bangkok, 15% in Ban-na watch at weekends only. The χ^2- test for homogeneity is not a significant difference between both groups (χ^2 = 3.5, df = 2 P-value >0.10). The charateristics shown in table 19.

As a result, are could say that both groups belong to the same psychosocial characteristics level.

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Table 19 Number and percentage distribution of psychosocial characteristics

Psychosocial Characteristics	Bangkok number	Bangkok %	Ban-Na Number	Ban-Na %	χ^2	df	P-value
Roller skating							
Yes	9	13.43	2	3.33	2.41	1	>0.10
No	58	86.57	58	96.67			
Attendance at disco-theque							
Yes	-	-	-	-		1	
No	67	100.00	60	100.00			
Dating							
Yes	-	-	-	-			
No	67	100.00	60	100.00			
Frequency of going to movies							
1 time/wk	2	2.99	1	1.67			
1-2 time/month	10	14.92	8	13.33	2.6	3	>0.25
2-3 month/time	11	16.42	5	8.33			
never been to	44	65.67	46	76.67			
Preferred magazine reading							
Cartoon	11	16.42	19	31.67			
Movie star pictures	5	7.46	4	6.67			
Fiction	-	-	-	-	9.5	6	>0.10
Cartoon+ movie star	20	29.85	16	26.67			
Cartoon+ fiction	1	1.49	1	1.67			
Movie star + fiction	3	4.48	-	-			
Cartoon + movie star + fiction	19	28.36	9	15.00			
Don't like to read	8	11.94	11	18.32			

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Table 19 (Cont.)

Psychosocial characteristics	Bangkok		Ban-Na		χ^2	df	P-value
	number	%	Number	%			
Frequency of television watching							
Everyday	58	86.56	45	75.00	3.5	2	>0.10
Weekend only	7	10.45	9	15.00			
Don't watch	2	2.99	6	10.00			

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2.7 Sexual stimuli scores

The comparison of mean menarcheal age according to sexual stimuli scores are shown in table 20. It was found that those with higher sexual stimuli scores will also have had higher mean menarcheal age both in Bangkok and Ban-na. When combining the 2 groups together, the lower sexual stimuli scores group (0 score) have a significantly lower mean menarcheal age than the higher group (2 scores). It could be concluded that the exposure to sexual stimulation depends on age rather than menarcheal age.

3. Anthropometric characteristics

3.1 Growth assessment for weight and height

The comparison of weight and height between both groups according to mean menarcheal age is shown in table 21. In general weight and height are correlated to age (in the growth period). It means younger girls will have an average weight and height lower than the older girls. When comparing average weight and height with menarcheal age, it is found that the late menarcheal group (15-16 yr. at mean menarcheal age) is lesser in weight and height than the other groups in Bangkok and Ban-na. The average weight and height of both groups shows no significant difference ($t = 1.060$, $df = 132$, P-value > 0.1 in weight, $t = 0.188$, $df = 17$, P-value > 0.25 in height)

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Table 20 Number, mean and standard deviation of menarcheal age of the girls in Bangkok and Ban-na according to sexual stimuli scores.

Sexual stimuli scores	Bangkok			Ban-na			Total		
	n	menarcheal age $\bar{x}$	SD	n	menarcheal age $\bar{x}$	SD	n	menarcheal age $\bar{x}$	SD
0	33	12.62	1.13	33	12.89	0.91	66	12.75+	1.03
1	22	13.06	0.85	21	13.24	1.04	43	13.14	0.94
2	6	13.50	1.15	6	13.89	0.72	12	13.69+	0.90
3	4	13.15	1.17	-	-		4	13.15	1.17
4	1	13.67		-	-		1	13.67	-
5	1	12.00		-	-		1	12.00	-

+ significant between 2 groups at p-value < 0.05

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Table 21 Number, mean and standard deviation of weight and height of the girls in Bangkok and Ban-Na according to mean menarcheal age

Mean menarcheal age (yr)	Weight				Height			
	Bangkok		Ban-Na		Bangkok		Ban-Na	
	n	$\bar{x} \pm SD$	n	$\bar{x} \pm SD$	n	$\bar{x} \pm SD$	n	$\bar{x} \pm SD$
10 - 11	4	35.60±8.86	2	40.20±1.70	4	138.12±6.06	2	148.25±1.77
11 - 12	10	43.32±6.48	5	40.56±6.77	10	146.50±6.61	5	148.50±6.08
12 - 13	25	41.34±7.01	21	39.25±4.91	25	150.06±5.25	21	149.07±6.13
13 - 14	19	41.21±8.18	23	39.31±3.62	19	151.45±9.50	23	149.65±3.67
14 - 15	7	39.46±5.13	8	41.17±3.66	7	151.43±5.34	8	150.62±5.63
15 - 16	2	33.10±4.10	1	38.20±0.00	2	144.00±3.53	1	147.50±0.00
Total	67	40.81±7.27	60	39.65±4.28	67	149.17±7.53	60	149.38±4.94
T-test for the total groups		1.060				0.188		
df		132				117		
P-value		>0.1				>0.25		

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3.2 Arm circumferences and tricep skinfold

The comparison of arm circumferences and tricep skinfold between both group according to mean menarcheal age are shown in table 22 and 23. The average arm circumferences and tricep skinfold of Bangkok group are significantly higher than Ban-na group. ($t = 3.2$, $df = 99$, P-value < 0.05, $t = 2.09$, $df = 124$, P-value < 0.05)

Table 22 Number, mean and standard deviation of arm circumferences of the girls in Bangkok and Ban-Na according to mean menarcheal age

Mean menarcheal age(yr)	Bangkok			Ban-Na			t-test
	N	Arm cir		N	Arm cir		
		mean	SD		mean	SD	
10 - 11	4	22.12	4.09	2	22.50	1.41	-
11 - 12	10	23.59	2.56	5	21.40	2.77	-
12 - 13	25	22.85	3.83	21	21.26	1.41	-
13 - 14	19	22.21	2.71	23	21.42	1.52	-
14 - 15	7	21.71	1.25	8	21.96	1.10	-
15 - 16	2	18.80	0.28	1	22.50	0.00	-
Total	67	22.49	3.14	60	21.49	1.53	3.2*

*at $df = 99$, $p < 0.05$

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Table 23 Number, mean and standard deviation of tricep skinfolds of the girls in Bangkok and Ban-Na according to mean menarcheal age.

Mean menarcheal age (yr)	Bangkok			Ban-Na			t-test
	N	Tricep skinfold		N	Tricep skinfold		
		mean	SD		mean	SD	
10 - 11	4	16.85	3.92	2	12.60	4.52	-
11 - 12	10	15.96	4.67	5	14.60	4.99	-
12 - 13	25	14.23	4.05	21	11.74	2.77	-
13 - 14	19	14.34	4.75	23	13.08	3.57	-
14 - 15	7	12.65	3.60	8	13.57	1.37	-
15 - 16	2	8.60	1.70	1	20.40	0.00	-
Total	67	14.35	4.37	60	12.91	3.37	2.09*

*at df = 124, $p < 0.05$)

3.3 Body mass index (BMI)

When comparing body mass index, it is found that the average body mass index of both groups shows no significant difference (t= 1.57, df = 105, P-value > 0.05) shown in table 24.

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Table 24 Number, mean and standard deviation of body mass index of the girls in Bangkok and Ban-Na according to mean menarcheal age.

Mean menarche age (yr)	Bangkok N	Bangkok BMI mean	Bangkok BMI SD	Ban-Na N	Ban-Na BMI mean	Ban-Na BMI SD	t-test
10 - 11	4	21.45	6.53	2	18.31	1.21	-
11 - 12	10	19.89	2.71	5	18.42	3.24	-
12 - 13	25	18.33	2.73	21	17.66	1.55	-
13 - 14	19	17.90	2.89	23	17.63	1.64	-
14 - 15	7	17.20	2.01	8	18.15	1.23	-
15 - 16	2	15.95	1.20	1	17.56	0.0	-
Total	67	18.48	3.08	60	17.80	1.68	1.57*

*at df = 105, P > 0.05

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From the dataof growth assessment, it is found that the two study-groups belong to the same weight and height but different arm circumferences and tricep skinfold. Bangkok girls seems to have more sbucutaneous fatthan Banna's girls. So in this study, using weight for height for age to classify the nutritional status.

The hypothetical factors affecting menarcheal age.

1. Urban and rural environments An Independent variable was place of birth which were divided into Bangkok and Ban-na.

2. Nutritional status Independent variable was nutritional status which divided into well-nourished and undernourished (calculated from the reference standard weight for height for age by Burana Chavalittumrong et al.).

3. Socio-economic status An Independent variables were per capita income/month, (which divided into high and low) and daily luncheon allowance (which divided into high and low).

4. Protein consumption An Independent variable was protein consumption which was divided into high and low protein.

Since the hypothetical factors might have an interaction effect on each other. Factorial experiment designed to test the interaction effect was used for analysis (from table 25). It is found that no interaction effect exists between the factors, the main factors that influence the menarcheal age were nutritional status, (P-value = 0.001) luncheon allowance (P-value = 0.018) and protein consumption (P-value = 0.029).

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Table 25 Analysis of variance by source of variation

Source of variation			Sum of square	df	Mean square	F	signif.
P.			48.529	1	48.529	0.357	0.552
N.S.			1629.307	1	1629.307	11.971	0.001*
INC.			226.445	1	226.445	1.664	0.200
L.A.			794.643	1	794.643	5.838	0.018*
P.C.			668.834	1	668.834	4.914	0.029*
P.	N.S.		182.908	1	182.908	1.344	0.249
P.	INC.		2.404	1	2.404	0.018	0.085
P.	L.A.		118.939	1	118.939	0.874	0.352
P.	P.C.		2.258	1	2.258	0.017	0.898
N.S.	INC.		215.340	1	215.340	1.582	0.211
N.S.	L.A.		54.579	1	54.579	0.401	0.528
N.S.	P.C.		57.603	1	57.603	0.423	0.517
INC.	L.A.		81.909	1	81.909	0.602	0.440
INC.	P.C.		0.031	1	0.031	0.000	0.988
L.A.	P.C.		131.691	1	131.691	0.968	0.328
P.	N.S.	INC.	342.086	1	342.086	2.513	0.116
P.	N.S.	L.A.	81.812	1	81.812	0.601	0.440
P.	N.S.	P.C.	11.444	1	11.444	0.084	0.772
P.	INC.	L.A.	84.334	1	84.334	0.620	0.433
P.	INC.	P.C.	3.160	1	3.160	0.023	0.879
P.	L.A.	P.C.	74.785	1	74.785	0.549	0.460
N.S.	INC.	L.A.	204.535	1	204.535	1.503	0.223
N.S.	INC.	P.C.	125.829	1	125.829	0.924	0.339
N.S.	L.A.	P.C.	224,956	1	224.956	1.653	0.202
INC.	L.A.	P.C.	96.382	1	96.382	0.708	0.402
Residual			13202.176	97	136.105		
Total			18718.398	122	153.429		

P. = Place of birth, N.S. = Nutritional status.

INC. = Per Capita Income L.A. = Luncheon allowance,

P.C. = Protein consumption

*Significant at P-value <0.05

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The comparison of mean menarcheal age according to the hypothetical factors are shown as following :

1. Urban - rural enviroment A comparison of mean menarcheal ages between Bangkok and Ban-na groups do not show any significant differences (F-test = 0.357, P-value = 0.552 shown in table 26)

Table 26 Comparison of the number, mean and standard deviation of menarcheal age of the girls in Bangkok and Ban-Na

	N	Age of menarche				F-test	P-value
		mean	SD	χ^2	df		
Bangkok	67	12.88	1.03	2.27	3	0.357	0.552
Ban-Na	60	13.11	0.97	2.35	3		

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2. Nutritional status Weight for height for age was used for classification the nutritional status. The subjects who had weight for height for age lesser than the 50^{th} standard percentile were undernourished. Since the urban - rural environment did not affect the menarcheal age and the two study groups belonged to the same nutritional status, so the 2 groups were gathered together and classified by nutritional status. The statistical analysis by the F-test shows that the well-nourished group had a mean menarcheal age significantly lower than the undernourished group : (F-test = 11.971 P-value = 0.001) shown in table 27

Table 27 Comparison of the number, mean and standard deviation of menarcheal age of the girls according to nutritional status

Nutritional status	N	Mean menarcheal age	SD	F-test	P-value
well-nourished	70	12.63	0.97	11.971	0.001
Undernourished	57	13.43	0.88		

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3. Socio - economic status Per capita income and luncheon allowance were used for the variables. From table 28, it is found that the mean menarcheal age according to per capita income is not significantly difference (P = 0.200)

Table 28 Comparison of the number, mean and standard deviation of menarcheal age according to per capita income.

Per capita income	N+	Mean menarcheal age (yr)	SD	F-test	P-value
High	67	13.04	1.01	1.664	0.200
Low	56	12.90	1.02		

+ Loss of 4 cases

The comparison of the mean menarcheal age according to nutritional status and per capita income was shown in table 29. In the well nourished group, mean menarcheal age of the higher per capita income group is not a significant difference from the lower per capita income group (t-test = 1.50, df = 67, P-value = 0.07). In the undernourished group, there is not a significant difference between the 2 groups (t-test = 0.08, df = 52, P-value = 0.47). When the higher per capita income is fixed, the mean menarcheal age of the well-nourished group is significantly lower than the undernourished group (t-test = 2.69, df = 65, P-value < 0.005). When the lower per capita income is fixed, the mean menarcheal age of the well-nourished girls is significantly lower than the undernourished group (t-test = 4.23, df = 54 , P-value < 0.001) It means that per capita income does not affect the menarcheal age.

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Table 29 Comparison of the number, mean and standard deviation of menarcheal age according to nutritional status and per capita m income.

Per capita income	Well-nourished N	Mean menarcheal age(yr.)	SD	Undernourished N	Mean menarcheal age(yr.)	SD	t-test	df	P-value
High	39	12.76	0.98	28	13.42	0.94	2.69	65	<0.005
Low	30	12.42	0.95	26	13.44	0.83	4.23	54	<0.001
t-test		1.50			0.08				
df		67			52				
P-value		0.07			0.47				

The other variable to represent the socio-economic status was luncheon allowance. It is found that the mean menarcheal age of the high luncheon allowance group is significantly lower than the low luncheon allowance group (F = 5.838, P-value = 0.018 from table 30).

Table 30 Comparison of the number, mean and standard deviation of menarcheal age according to luncheon allowance

Luncheon allowance	N	Mean menarcheal age	SD	F-test	P-value
High	68	12.70	0.96	5.838	0.018
Low	59	13.31	0.97		

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When comparing the mean menarcheal age by nutritional status and luncheon allowance. In the well-nourished group, the mean menarcheal age of the high luncheon allowance is significantly lower than the low ones ($t = 1.83$, $df = 68$, P-value = 0.036). In the undernourished group, the mean menarcheal age of the high luncheon allowance is significantly lower than the low one too ($t = 1.75$, $df = 55$, P-value = 0.043). It shows that luncheon allowance affects the menarcheal age. When the high luncheon allowance and the low luncheon allowance are fixed, it shows the same results, the well-nourished group has a mean menarcheal age significantly lower than the undernourished group ($t = 29$, $df = 43$, P-value < 0.005 for the high luncheon allowance, $t = 2.44$, $df = 46$, P-value < 0.01 for the low luncheon allowance)(Table 31).

Table 31 Comparison of the number, mean and standard deviation of menarcheal age according to nutritional status and luncheon allowance.

Luncheon allowance	Well-nourished			Undernourished			T-test	df	P-value
	N	$\bar{X}$	SD	N	$\bar{X}$	SD			
High	46	12.47	0.89	22	13.17	0.95	2.9	43	<0.005
Low	24	12.92	1.07	35	13.58	0.80	2.44	46	<0.01
t-test		1.83			1.75				
df		68			55				
P-value		0.036			0.043				

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4. Protein consumption In this study, the subjects are considered as having low protein consumption when they consumed protein lower than 75% of RDA standard (WHO, 1985) and scores of protein consumption pattern was lower than 50th percentile of total scores. The subjects who did not meet the above criteria was considered as the high protein consumption group. From table 32, the mean menarcheal age of the high protein consumption is significantly lower than the low protein consumption group (F = 4.914, P-value = 0.029). It means that protein consumption affects the menarcheal age.

Table 32 Comparison of the number, mean and standard deviation of menarcheal age according to protein consumption

Protein consumption	N	Mean menarcheal age	SD	F-test	P-value
High	67	12.76	1.05	4.914	0.029
Low	60	13.23	0.89		

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In a comparison of the mean menarcheal age according to protein consumption and nutritional status it is found that the mean menarcheal age of the well-nourished group is significantly lower than the undernourished group neither in the high protein consumption group nor the low group ($t = 3.41$, $df = 61$, P-value <0.005, $t = 3.23$, $df = 61$, P-value < 0.005). When the well-nourished group is fixed, the high protein consumption group has a mean menarcheal age significantly lower than the other group ($t = 2.01$, $df = 69$, P-value $= 0.025$). But when the undernourished group is fixed, there is no significant difference between the high and low protein consumption groups ($t = 1.33$, $df = 52$, P-value $= 0.10$) (from table 33).

Table 33 Comparison of the number, mean and standard deviation of menarcheal age according to nutritional status and protein consumption.

Protein consumption	Well-nourished			Undernourished			t-test	df	P-value
	N	$\bar{X}$	SD	N	$\bar{X}$	SD			
High	40	12.44	1.00	27	13.27	0.96	3.41	61	<0.005
Low	30	12.89	0.87	30	13.58	0.78	3.25	61	<0.005
t-test		2.01			1.33				
df		69			52				
P-value		0.025			0.10				

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Table 34 is a comparison of calories, gm of carbohydrates and gm of fat between the high and low protein consumption group. It is found there is no significant differences of calories and gm of carbohydrates between both groups. But there is a significant difference is terms of fat ($t = 4.03$, $df = 12.5$, P-value < 0.0005)

Table 34 Comparison of mean and standard deviation of calories, carbohydrate (gm), and fat (gm) according to protein consumption.

Protein consumption	Number	Calories $\bar{X} \pm SD$	CHO(gm) $\bar{X} \pm SD$	Fat (gm) $\bar{X} \pm SD$
High	67	1564.09±302.65	211.93±51.89	59.02±16.49
Low	60	1451.05±479.63	214.49±85.16	47.07±16.83
t-test		1.57	0.20	4.03
df		99	97	125
P-value		0.06	>0.25	<0.0005

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When comparing the mean menarcheal age according to nutritional status and fat intake. Table 35 shows that in the well-nourished group and undernourished group, the mean menarcheal age of higher fat intake group is significantly lower than the lower group ($t = 1.73$, $df = 67$, P-value < 0.05, $t = 1.96$, $df = 40$, P-value < 0.05). In the high fat intake and the low fat intake group, the mean menarcheal age of the well-nourished group is significantly lower than the undernourished group. ($t = 2.66$, $df = 50$, P-value < 0.005, $t = 3.8$, $df = 55$, P-value < 0.0005)

Table 35 Comparison of the number, mean and standard deviation of menarcheal age according to nutritional status and fat intake.

Fat intake	Well-nourished			Undernourished			t-test	df	P-value
	n	$\bar{x}$	SD	n	$\bar{x}$	SD			
High	42	12.47	1.02	24	13.16	1.01	2.66	50	< 0.005
Low	28	12.86	0.85	33	13.63	0.71	3.8	55	< 0.0005
t-test		1.73			1.96				
df		67			40				
P-value		< 0.05			< 0.05				

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The relationship of the variables affecting the menarcheal age

Among factors influencing the menarcheal age, the interrelationship is shown in table 36 It appears that luncheon allowance is positively correlated with per capita income ($r = 0.28814$, $P < 0.05$) and gm of animal protein ($r = 0.15691$, $P < 0.05$) Animal protein intake (gm) is also significantly positive correlated with gm of fat intake. ($r = 0.27818$, P-value < 0.05)

Table 36 Correlation coefficient among the variable affecting the menarcheal age

	Luncheon allowance	Gm of animal protein
Per capita income	0.28814*	-0.00641
Gm of animal protein	0.15691*	-
Gm of fat intake	0.00857	0.27818*

*Significant at P-value < 0.05

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CHAPTER V

Discussions and Recommendation

In the study of factors affecting menarcheal age which have been conducted so far it could be concluded that there are many contributing factors, e.g. nutritional status, socio-econmic, seasonal variation, enviromental factors etc. However, most of the reasearches tend to stress their areas of interests on rather specific factors. Dreizen et.al. (1967) studies nutritional factors, and reported that in a longitudinal study of 30 undernourished and 30 well - nourished girls from early childhood to early adulthood confirm that chronic undernutrition postpones menarche. But left behind other related or contributing factors. Madhaven (1965) studied socio-economic status, then noted that the girls of the higher socio-economic strata tended to attain menarche earlier than the girls from lower socio-economic groups. In this study, an attempt had been made to study each anticipating factor relating to menstruation at the same time. For each contributing factor, urban and rural enviroment was the main focus since a number of researches in the past showed lower average of menarcheal age in urban girls than the rural because the former group grew-up among better socio-economic and and ntritional status. In this study The sampling was controlled by selection from the same school level and economical background , so both urban and rural children grew-up in the same socio-economic and nutritional status. Of the 67 cases in Bangkok (12.96 %) and 60 cases in Ban-na, (table 14) it was found that.

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situation. However the major occupations in both area are still ranked at the same socio-economic level. Attallah et.al. (1983) concluded that the girls whose parent were mostly senior professionals had a mean menarcheal age earlier than the girls whose parent were skilled and unskilled labourers.

1.3 Parent's education : From table 18, it was found that there were no differences among the mothers' educational background but Bangkok showed a lower educational level of the fathers than Ban - na. This may look somewhat strange from general Thai's picture where the rural group always shows inferior socio - economical status than the rural people. Laska et.al. (1982) reported that the factors responsible for the delayed maturation of rural girls, in comparison with the urban population, was the lower education level of the rural population. In this study it could be said that both groups belong to the similar socio - economical level but the Ban - na group is more advantageous in terms of fathers' education.

2. Psychosocial characteristics

The statistical analysis by χ^2 - test for homogeneity in table 19 showed that there were no significant different psychosocial characteristics between both groups. Although there were the differences between urban and rural environment, psychosocial characteristics which characterized urban and rural were not evident in these two groups. So it could be said that both groups belonged to the same psychosocial characteristics level. When the psychosocial characteristics in terms of sexual stimuli scores are considered it has been expected the early menarche group would be exposed to sexual stimulation more than the

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late menarcheal group. But in this study, it is found that the sexual stimuli scores depended on the age not the menarcheal age.

Because of the small sample size and the similar psychosocial characteristics between both groups, so it can not be concluded that psychosocial characteristics exposure to have no effect on the menarcheal age. Further study with the better psychosocial indicators should be continued in order to elucidate the true effect of this factor on menarche.

3. Anthropometric characteristics

From the data collected, weight, height, arm circumference, tricep skinfold and body mass index are indeces of anthropometric characteristics. Although table 22 and 23 showed that girls in Bangkok tend to have more subcutaneous fat then those in Banna, the average weight, height and body mass index showed no differences in both groups. (table 21, 24). The weight and height relation can be considered as an important standard of the nutritional status (Frisch and Revelle 1972). So it could be concluded that the study-groups belonged to not only the same socio-economical level but also nutritional status.

In addition, no difference is found in the average age at menarche between these two groups in spite of their significantly different arm circumference and triceps skinfold. This evidence suggests that these two parameters are not very sensitive in classifying the nutritional status comparing to weight for age, height for age and weight for height for age.

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The hypothetical factors affecting menarcheal age.

The factors tobe considered here as affecting the menarcheal age were urban and rural environments nutritional status, socio-economic status and protein consumption. Factorial experiment was designed to detect the type of effect. It is called interaction. In table 25 it is shown that there is no interaction among the variables. It means that the augmentation property applies to the main effects; that they are independent. Factors that affect the menarcheal age are nutritional status, luncheon allowance and protein consumption. Inorder to understand easily, the next discussions are as follows :

1. Urban and rural environments This study is different from that of the other ones . The samples selected had lived in different envrironmental situations but the same socio- economical level and nutritional status. From table 26 it was found that there is no significant difference in the mean menarcheal age of schoolgirls in Bangkok from that in Ban-na. However, befor accepting this finding as an actual relationship, futther considerstion of the controversial study situation is necessary. First of all, this is a pioneer study concerning the instrument assessing the psychosocial differences between urban and rural areas, so there has been no guideline to be in the construction of the assessment instrument. Therefore, the psychosocial assessment might not be valid enough for differentiate the urban and rural experience of the subject. In this case, the influence of psychosocial factor on menarche, even though exists, would not be found in this study. Secondary if the psychosocial assessment instrument used in this study is a valid and reliable one, the effect of psychosocial factor on menarche might not be found in this study due to one of the limitations presented in i.e.

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the distance between the two areas. Since Ban-na is not far way from Bangkok, with a slightly better socio-economic status, these rural girls have a good change to exposing to Bangkok environment as much as Bangkok girls. A number of studies in the past showed that the average menarcheal age of urban girls was lower than in the rural girls (Robert et.al. 1977; Manniche, 1983 ; Prakashand Gayathiri Pathmanathan, 1984) Urban and rural differences in menarcheal age in India have reported by Madhavan (1965) and Sen (1953) Madhavan studied 1010 girls from rural areas and 785 girls from urban areas in the states of Kerala and Medras in Southern India, the following mean menarcheal age are given below for these two states :

Kerala : urban 13.24 range 12.88 - 13.35; rural 14.42 , range 14.13 - 14.69

Madras : urban 12.76, range 12.47 - 13.05; rural 14.16, range 13.84 - 14.35

Of those girls from urban areas, who menstruated earlier than those from rural areas, 50 - 70 % were in the high socio-economic groups while 90 % of those rural girls are from low socio-economic groups. Sen's group of high caste Brahmin, Vaidya add Kayastha girls from the city of Calcutta constituted the urban sample, while the group of Bagdis from the village of Moydah were the rural one. There were obvious differences in menarcheal age between these two groups. The urban group's mean menarcheal age was 12.78, s.e. $\pm$ 0.05 years compared to the Bagdis's rural group of 13.25, s.e. $\pm$ 0.05 years.

2. Nutritional status Nutrition has been accepted as an important factor affecting menarcheal age. This study found that the well-nourished had a menarcheal age lower than the undernourished singnificantly, (table 27) which agrees with the study of Tanner

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(1962) and other investigators. Tanner concluded that girls at menarche are taller and heavior than those of the same age who have not achieved menarche. The study of Dreizen et.al. (1967) showed that the early menarche group has a rate of skeletal maturation more than late menarche group. Simons and Greulich (1943) concluded that early menarche are not only people whose growth to maturity is advanced at all ages, they are also people who as adults have more weight for height than late menarche. Frisch and Revelle (1969) stated that nutrition is the determining factor in the difference between urban and rural people at the time of maximum increment in growth in weight (MIGW) and maximum increment ingrowth in height (MIGH), which precedes menarche in India. Urban Indian females are also heavior than rural females by 3.8 kg. Kark (1943) studied four groups of South African Bantu girls (total of 1088) of the same ethnic origin but living in widely different environments. She found that the girls in the more southern, temperate climate and better physiques less evidence of malnutrition or specific disease and earlier menarche than those living in the hotter northern area, where biharzia, malaria and malnutrition were prevalent.

3. Socio-economic status

In the study of socio-economical factors, per capita income and daily luncheon allowance are two variables used as its indicators which are expected as reliable predictors. The results show no difference in the menarcheal age of the higher or lower income groups when per capita family income is used as the indicator. However, the classification of the higher and lower incomes groups might not be valid enough. Because the study has been design for similar socio-economic status of both

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groups so the variation may not be wide enough to serve this purpose of study. But when daily luncheon allowance is used, it is found that the girls with higher luncheon allowance have statistically lower menarcheal age. (table 30). Eventhough there has been no one who has ever used luncheon allowances as economic indices before but it is more reliable than the answers the girls could give concerning family income. Furthermore, luncheon allowance might be anticipated to associate to the age at menarche more than per capita income because this amount of money belongs directly to the subject, thus it reflects not only the socio-economic status of the girls but also their food intake quality. Table 36 shows that Luncheon allowance correlates significantly with animal protein intake which, in turns, affect the age of menarche, so it is possible that the luncheon allowance plays its role on menarche by increasing the subjects' protein intale. However, luncheon allowance may effect the age at menarche through other mechanism or not is beyond the scope of this study. A positive correlation exists between luncheon allowance and per capita income (Table 35) Although per capita income did not affect the menarcheal age, it correlates significantly with luncheon allowance which affected the menarcheal age. So it may concluded that per capita family income had on indirect effect to the menarcheal age.

From the literature reviewed, Israel (1959) found that girls from homes with an income of Rs 500 and over per month menstruated 6 months earler (13.0 years) than girls from families whose monthly income was below Rs 150. Kamat and Kamat (1959) also found that menarche for girls in their low income group was at 13.4 years while it was at 13.1 years for girls in their high income group. Medhaven (1965) also noted that children of higher socio-economic strata tend to attain puberty earlier than those from lower socio-economic groups. As same as

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the study of Robert et.al. (1977), Malina et.al.(1977), Laska et.al. (1982) and Attallah et.al.(1983). In these studies however, the effect of the different nutritional status was not controlled. After controlling the effect of nutritional status, the effect of luncheon allowance on menarche still persist in this study which confirms that the socio-economic status itself is one of the factors affecting menarche, possibly by increasing animal protein purchasing power and intake of the samples.

4. Protein consumption In terms of protein consumption it was found that the girls who consumed higher protein intake showed statistically lower menarcheal age than the girls who consumed low protein intake (table 32). This agrees with Kralj-cercek (1956) who studied the sexual development of 148 Slovenian girls and observed that for girls whose diet was rich in protein, the mean age at menarche was 12.65 (= 0.13 S.E.) years, whereas for those whose diet was largely carbohydrate, it was 14.1(= 0.11 S.E.) years. Burrell et al. in their 1961 study of Bantu girls found that girls classified by the school authorities as "poor" had a mean menarcheal age of 15.42 (= 0.04 S.E.) years where as those designated as "not poor" (on the basis of a larger intake of animal protein) experenced menarche at 15.02 (= 0.05 S.E.) years.

But when compared to average menarcheal age classified according to nutritional status and protein consumption (table 33) It was found that well-nourished group with a high protein intake had an average menarcheal age statistically lower than well -nourished who consumed a low protein intake. For the undernourished group, it was found that in neither high nor low protein consumption group the average menarcheal age was not statistically different.(p-value = 0.10). This result is different from table 25 which was analyzed by analysis of variance.

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It was found that protein consumption affected the menarcheal age and there was no interaction affect between protein consumption and the Nutritional status. The analysis of variance was believed and suited this study better than the t-test, because it adjusted the other main effect and interaction.

For the results from table 33, it could be explained that the undernourished group did not obtain enough calories so some portion of protein is used as energy source rather than for growth or producting biological active substances needed for body synthesis, so the high amount of protein apparently consumed becomes equivalent to the low amount for utilization in physiological growth.

When compared the average calories, carbohydrate (gm) and fat (gm) intake of the high protein to the low protein group, it was found that the mean of calories and carbohydrates were not statistically different (table 34). But those with a higher protein intake consumed significantly more fat than the low protein group. This evidence explains would also consume a higher fat intake. This was supported by the correlation of gm of animal protein and gm of fat. (table 36).

In order to verify which of the two nutrients is the factor affecting the age of menarche futher analysis has been done and presented in Table 35. The fat intake was classified as higher and lower according to 30% of tatol colories which was not less than 75% of RDA. (WHO, 1985, see appendix E) Higher means to fat's energy is not less than 30% of total energy. Lower means to fat's energy is lower than 30% of total energy. When comparing the average menarcheal age according to nutritional status and fat intake, it was found that the higher fat intake group had a menarcheal age lower than the lower ones significantly both in well-nourished and undernourished group (table 35). Although one

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question of which of the two nutrients, fat or protein, is responsible in shifting the menarcheal age, arises, the different patterns of their relationship to the menarcheal age seem to suggest that both of them have separate effect on the age at menarche. This matter needs further investigation.

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RECOMMENDATION

From the results obtained from this study concerning the factors affecting the age at menarche and the results of other studied concerning the age and menarche and pregnancy outcome it is recommended that :

1. Education be given to girls before puberty on factors affecting menarche and the relationship of menarche on pregnancy outcome.

2. Nutrition education be given to girls during school age in order to improve their nutritional status before reaching puberty.

3. Low-price, high-quality protein food be emplasized for the community with low socio-economic status in order to raise their amount of protein consumption.

From the constraints encountered in this study it is recommended for the future study that :

1. The place of study be a better representative of the urban and rural environments.

2. The duration of study be longer than 6 months so that the sample size is large enough for the multi-stage controlling of the effects of various variables simultaneously.

3. Indicators of the level of exposure to psychosocial stimulation be developed in order that it can differentiate between urban and rural girls.

4. Other factors such as heredity, fat intake be included in the study.

5. A longitudinal study would be preferrable since menarche is the result of a long process of the growth and development of the reproductive organ.

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SUMMARY

The study was performed inorder to determine the factors that influence the menarcheal age. One hundred and twenty - seven schoolgirls and residence, were the subjects. They were divided into two group according to their place of birth, sixty - seven in Bangkok and 60 in Ban-na. They were measured for weight, height, arm circumferences and tricep skinfold then answered the designed questionaire and recorded their food intake for 3 days. After each day of food recording, the food intake data were confirmed by using the 24 - hour dietary recall method. The two groups are similar in terms of socio-economic and nutritional status. Data collected within 2 weeks after having first menstruation. The study results show that :

1. The average menarcheal age of the urban schoolgirls is not significantly different from that of the rural ones.
2. The average menarcheal age of the well-nourished schoolgirls is lower than that of the undernourished ones.
3. After controlling for the effect of nutritional status, the direct socio-economic indicator which is the girls' luncheon allowance exerts its negative effect on the age at menarche whereas the indirect indicator which is the per capita family income does not.
4. The average age at menarche of the girls who consumed high protein intake is significantly lower than that of those who consumed low protein intake in the well-nourished group.

In this study, the hypothetical factors are concluded in the fig 15.

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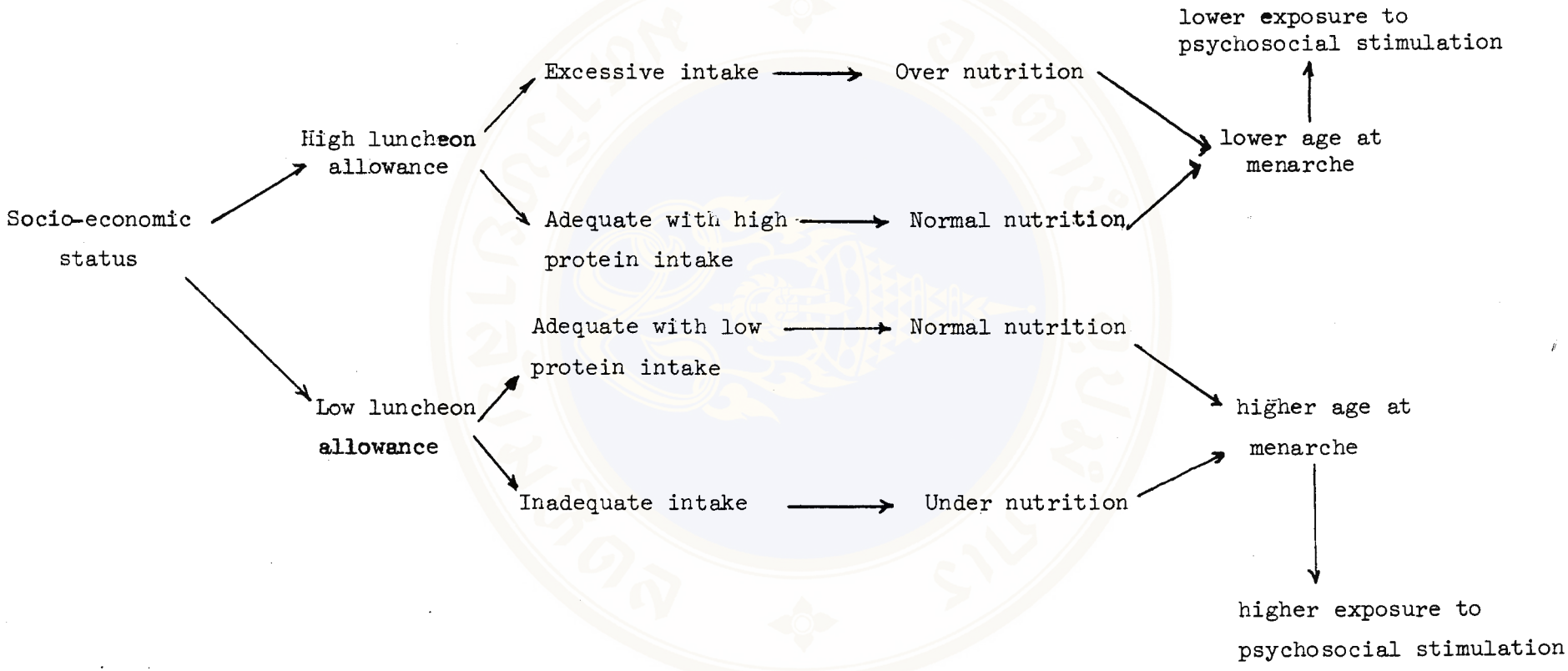

Fig 15. Interrelationships of the hypothetical factors influencing age at menarche.

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Appendix A

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Appendix A

Table 1 A Frequency and percentage distribution of samples by per capita income/month.

Per capeta income/month (baht)	Bangkok		Ban-na	
	number	%	number	%
≤ 500	18	27.27	23	40.35
501 - 1000	27	40.91	18	31.58
1001 - 1500	12	18.18	6	10.53
1501 - 2000	2	3.03	5	8.77
> 2000	7	10.61	5	8.77
Median	900		600	

Table 2 A Frequency and percentage distribution of samples by daily luncheon allowance

Luncheon allowance (baht)	Bangkok		Ban-na	
	number	%	number	%
Partom 5 - 6				
≤ 5	3	17.65	2	22.22
6 - 10	7	41.18	7	77.78
11- 15	4	23.53	0	-
16- 20	2	11.76	0	-
> 20	1	5.88	0	-
Median	10		7	
Matayom 1				
≤ 5	0	-	3	11.54
6 - 10	3	20.00	15	57.69
11- 15	7	46.67	5	19.23
16 - 20	5	33.33	3	11.54
> 20	0	-	0	-
Median	14		10	

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Table 2 A (cont,)

Luncheon allowance (baht)	Bangkok		Ban-na	
	number	%	number	%
Matayom 2				
⩽ 5	0	-	3	11.54
6 - 10	3	20.00	15	57.69
11 -15	7	46.67	5	19.23
16 -20	5	33.33	3	11.54
> 20	0	-	0	-
Median	14		10	
Matayom 3				
⩽ 5	0	-	0	-
6 - 10	2	28.57	2	50
11 - 15	1	14.29	2	50
16 - 20	3	42.86	0	-
> 20	1	14.28	0	-
Median	16		11	

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Table 3 A Frequency and percentage distribution of samples by level of protein consumption pattern scores.

Protein consumption pattern scores	Number	%
≤ 10	12	9.45
11 - 20	25	19.69
21 - 30	56	44.09
31 - 40	31	24.41
> 40	3	2.36
Median	25	

Table 4 A Frequency and percentage distribution of samples by level of of protein intake

Protein intake	Number	%
75 % RDA*	13	10.24
75 % RDA	114	89.76

* From WHO 1985

Table 5 A Frequency and percentage distribution of samples by protein intake and protein consumption pattern scores.

Protein intake	Protein consumption pattern scores	
	< 25	≥ 25
75 % RDA	6	7
75 % RDA	47	67

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Appendix B

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Appendix B

แบบสอบถาม

เรื่อง

ปัจจัยที่มีอิทธิพลต่ออายุของการมีระดู

คำชี้แจง แบบสอบถามชุดนี้แบ่งเป็น ๓ ข้อใหญ่ ๆ มีคำถามทั้งหมด ๔๑ ข้อ คือ

๑. ข้อมูลส่วนบุคคล มี ๓๒ ข้อ

๒. ข้อมูลเกี่ยวกับการออกกำลังกาย มี ๕ ข้อ

๓. ข้อมูลเกี่ยวกับการบริโภคอาหาร มี ๔ ข้อ

ให้นักเรียนเติมคำในช่องว่างหรือกาเครื่องหมาย (✓) ลงใน ☐ ให้ตรงกับความเป็นจริง (โปรดตอบให้ครบทุกข้อถาม มิฉะนั้นจะไม่สามารถนำไปใช้ให้เกิดประโยชน์ได้)

๑. ข้อมูลส่วนบุคคล

๑. ชื่อ.....นามสกุล.....

๒. ชื่อโรงเรียน.....ชั้น.....

๓. เกิดวันที่.....เดือน.....พ.ศ.....

๔. มีประจำเดือนครั้งแรกวันที่.....เดือน.....พ.ศ.....

๕. เชื้อชาติ.....

๖. สัญชาติ.....

๗. นับถือศาสนา.....

๘. จังหวัดที่เกิด..... ๙. ที่อยู่ปัจจุบัน.....

๑๐. ที่อยู่ปัจจุบันอยู่มา

☐ ตั้งแต่เกิด

☐ เพิ่งย้ายมาอยู่ (ระบุจำนวนปีที่ย้ายมาอยู่) .....ปี

☐ อื่น ๆ(ระบุ).....

๑๑. มีโรคประจำตัวหรือไม่

☐ มีคือโรค.....

☐ ไม่มี

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๑๒. อาชีพของบิดา (ตอบอาชีพหลัก)

☐ รับราชการ ☐ เกษตรกรรม

☐ ค้าขาย ☐ รับจ้าง (ระบุ).....

☐ อื่น ๆ (ระบุ).....

๑๓. การศึกษาสูงสุดของบิดา

☐ ต่ำกว่า ป.๔ ☐ ชั้น ป.๔ ☐ ชั้นมัธยมศึกษา

☐ ปวช., ปวส. ☐ ปริญญาตรี ☐ สูงกว่าปริญญาตรี

☐ อื่น ๆ (ระบุ).....

๑๔. อาชีพของมารดา (ตอบอาชีพหลัก)

☐ รับราชการ ☐ รับจ้าง ระบุ.....

☐ ค้าขาย ☐ เกษตรกรรม

☐ แม่บ้าน ☐ อื่น ๆ (ระบุ).....

๑๕. การศึกษาสูงสุดของมารดา

☐ ต่ำกว่า ป.๔ ☐ ชั้น ป.๔ ☐ ชั้นมัธยมศึกษา

☐ ปวช.,ปวส. ☐ ปริญญาตรี ☐ สูงกว่าปริญญาตรี

☐ อื่น ๆ (ระบุ).....

๑๖. อาชีพของผู้ปกครอง (ผู้อุปการะ).....

๑๗. พี่น้องที่มีชีวิตอยู่.....คน

๑๘. เป็นบุตรคนที่.....(ไม่รวมคนที่เสียชีวิต)

๑๙. จำนวนคนที่อาศัยอยู่ในบ้านทั้งหมด.....คน เกี่ยวข้องเป็น

☐ พ่อ ☐ แม่ ☐ พี่ ☐ น้อง ☐ ปู่ ☐ ย่า

☐ ตา ☐ ยาย ☐ ลุง ☐ ป้า ☐ น้า ☐ อา

๒๐. รายได้รวมของทุกคนในบ้านทั้งหมด.....บาท/เดือน

(รวมรายได้ของทุกคนที่ยังไม่หักค่าใช้จ่าย)

๒๑. ได้เงินมาโรงเรียนวันละ.....บาท หรือสัปดาห์ละ.....บาท

๒๒. เงินที่ได้มาโรงเรียนส่วนใหญ่

☐ เพียงพอ และมีเหลือเก็บ ☐ ไม่เพียงพอซื้ออาหารเป็นบางวัน

☐ เพียงพอซื้ออาหาร แต่ไม่มีเหลือเก็บ ☐ อื่น ๆ (ระบุ).....

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๒๓. เคยดูหนังตามโรงภาพยนตร์บ่อยครั้งแค่ไหน

☐ ๑ ครั้ง/สัปดาห์ ☐ ๑-๒ ครั้ง/เดือน ☐ ๒-๓ เดือน/ครั้ง

☐ แทบจะได้ได้ดูเลย ☐ อื่น ๆ (ระบุ).....

๒๔. ภาพยนตร์ที่ชอบดู (ตอบได้มากกว่า ๑ คำตอบ)

☐ ตลก ☐ ชีวิตรัก ☐ มู้หรือการต่อสู้

☐ ภูตผีปีศาจ ☐ อื่น ๆ (ระบุ).....

๒๕. ชอบอ่านนิยายรักหรือไม่

☐ ชอบ ☐ ความถี่.....เรื่อง/เดือน

☐ ไม่ชอบ ☐ อื่น ๆ (ระบุ).....

๒๖. ชอบอ่านหนังสือเกี่ยวกับดาราหรือไม่

☐ ชอบ ☐ ความถี่.....เล่ม/เดือน

☐ ไม่ชอบ

☐ อื่น ๆ (ระบุ).....

๒๗. หนังสือที่ชอบอ่านมากและอ่านบ่อยคือ (เรียงความถี่จากอ่านมากไปน้อย) (ไม่รวมหนังสือเรียนหรือหนังสือวิชาการ)

.....ความถี่.....ครั้ง/เดือน

.....ความถี่.....ครั้ง/เดือน

.....ความถี่.....ครั้ง/เดือน

.....ความถี่.....ครั้ง/เดือน

.....ความถี่.....ครั้ง/เดือน

.....ความถี่.....ครั้ง/เดือน

.....ความถี่.....ครั้ง/เดือน

.....ความถี่.....ครั้ง/เดือน

๒๘. ปกติดูทีวีบ่อยครั้งแค่ไหน

☐ ทุกวัน วันธรรมดาดูวันละ.....ชม. เสาร์-อาทิตย์ดูวันละ.....ชั่วโมง

☐ เฉพาะเสาร์-อาทิตย์ ดูวันละ..... ชม.

☐ ไม่ได้ดูเลย อื่น ๆ (ระบุ).....

๒๙. หนังทีวีที่ชอบดูมากที่สุดคือ (ระบุได้มากกว่าหนึ่งเรื่อง).....

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๓๐. เคยไปเล่นสเก็ตหรือไม่

☐ เคย (ระบุความถี่).....ครั้ง/เดือน สถานที่ที่ไป.....

☐ ไม่เคย

๓๑. เคยไปเที่ยวดิสโก้บ่อยครั้งแค่ไหน

☐ เคย (ระบุความถี่).....ครั้ง/เดือน สถานที่ที่ไป.....

☐ ไม่เคย.....

๓๒. เคยไปเที่ยวกับเพื่อนชายบ่อยครั้งแค่ไหน

☐ เคยไปสองต่อสอง (ระบุจำนวนครั้งที่ไป).....ครั้ง/เดือน

☐ เคยไปเป็นกลุ่มทั้งเพื่อนหญิงและเพื่อนชาย (ระบุจำนวนครั้งที่ไป).....ครั้ง/เดือน

☐ ไม่เคยไปเที่ยวกับเพื่อแลย

☐ อื่น ๆ (ระบุ).....

๒. <u>ข้อมูลเกี่ยวกับการออกกำลังกายก่อนมีประจำเดือนครั้งแรก</u>

๑. ปัจจุบันเป็นนักกีฬาของโรงเรียนหรือไม่

☐ ใช่ กีฬาที่เล่นคือ.....

☐ ไม่ใช่

☐ อื่น ๆ (ระบุ).....

๒. มีการออกกำลังกาย หรือเล่นกีฬานอกจากชั่วโมงพลศึกษาบ่อยครั้งแค่ไหน

☐ ทุกวันเป็นประจำ วันละ.....ชั่วโมง

☐ ๓-๔ ครั้ง/สัปดาห์ ครั้งละ.....ชั่วโมง

☐ ๑ ครั้ง/สัปดาห์ ครั้งละ.....ชั่วโมง

☐ นาน ๆ ครั้ง (ระบุ).....ครั้ง/เดือน

☐ ไม่ได้เล่นกีฬานอกจากชั่วโมงพลศึกษา

☐ อื่น ๆ (ระบุ).....

๓. ชนิดหรือประเภทของกีฬาที่เล่นบ่อยคือ (ระบุได้มากกว่า ๑ ชนิด).....

๔. ทำงานบ้านบ่อยครั้งแค่ไหน

☐ ทุกวัน งานที่ทำคือ.....ทำวันละ.....ชั่วโมง

☐ ๓-๔ ครั้ง/สัปดาห์ งานที่ทำคือ.....ทำวันละ.....ชั่วโมง

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☐ นานครั้ง (ระบุ).....ครั้ง/เดือน งานที่ทำคือ.....

☐ ไม่ต้องทำงานบ้านเลย

☐ อื่น ๆ (ระบุ).....

๕. พาหนะที่ใช้เดินทางจากบ้านมาโรงเรียน คือ

☐ รถโดยสารประจำทาง ใช้เวลาเดินทางจากบ้านมาโรงเรียน.....ชั่วโมง

☐ รถยนต์ส่วนตัว ใช้เวลาเดินทางจากบ้านมาโรงเรียน.....ชั่วโมง

☐ ถีบจักรยานมา ใช้เวลาเดินทางจากบ้านมาโรงเรียน.....ชั่วโมง

☐ เดินมาโรงเรียน ใช้เวลาเดินทางจากบ้านมาโรงเรียน.....ชั่วโมง

☐ อื่น ๆ (ระบุ).....

๓. ข้อมูลเกี่ยวกับการบริโภคอาหาร

๑. โดยปกติรับประทานอาหารวันละ.....มื้อ

๒. ลักษณะของการบริโรคอาหาร

ก. นมสด (ยกเว้นนมข้นหวาน)

☐ ดื่มเป็นประจำทุกวัน (ระบุชนิด).....ความถี่.....ครั้ง/วัน

☐ ดื่มเป็นบางวัน (ระบุชนิด).....ความถี่.....ครั้ง/วัน

☐ ไม่ดื่มเลย เหตุผล.....

ข. เนื้อสัตว์ (ได้แก่ เนื้อหมู, ไก่, วัว,ปลา)

☐ รับประทานทุกวัน ความถี่.....มื้อ/วัน

☐ รับประทานเป็นบางวัน ความถี่.....ครั้ง/สัปดาห์

☐ ไม่รับประทานเลย เหตุผล.....

ค. ไข่ (ได้แก่ ไข่ไก่, ไข่เป็ด)

☐ รับประทาน ความถี่.....ครั้ง/สัปดาห์

☐ ไม่รับประทาน เหตุผล.....

ง. อาหารทะเล (ได้แก่ ปลาหมึก, กุ้งทะเล, หอย, ปลาทะเล)

☐ รับประทาน ความถี่.....ครั้ง/สัปดาห์, ครั้ง/เดือน

☐ ไม่รับประทาน เหตุผล.....

จ. เครื่องในสัตว์ (ได้แก่ ตับ, หัวใจ,กะเพาะหมู)

☐ รับประทาน ความถี่.....ครั้ง/สัปดาห์, ครั้ง/เดือน

☐ ไม่รับประทาน เหตุผล.....

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ฉ. น้ำมัน, กะทิ

☐ รับประทาน (ระบุจำนวนมื้อที่รับประทานอาหารที่ไขมันประกอบต่อวัน).....มื้อ/วัน

☐ ไม่รับประทาน

๓. อาหารหมู่ใดที่ชอบและรับประทานบ่อยที่สุด (ตอบได้มากกว่า ๑ ข้อ)

☐ ข้าว, แป้ง, น้ำตาล

☐ เนื้อสัตว์ นม ไข่

☐ ผักต่าง ๆ

☐ ผลไม้ต่าง ๆ

☐ น้ำมันจากพืชและสัตว์

๔. อาหารหมู่ใดที่ไม่ชอบรับประทานมากที่สุด (ระบุได้มากกว่า ๑ ชนิด)

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แบบสอบถามเกี่ยวกับ sexual stimulation

กรุณาขีด ✓ ลงใน ☐ ให้ตรงกับความเป็นจริงของนักเรียน

๑. นักเรียนมีความคิดอย่างไรกับเรื่องการมีแฟนขณะเรียน

☐ ถ้ามีแฟนขณะเรียนแต่ไม่เสียการเรียนคิดว่าเป็นผลดีมากกว่าผลเสีย

☐ คิดว่าการมีแฟนขณะเรียนมักทำให้เกิดผลเสียมากกว่าผลดี

☐ มีแฟนแล้ว

☐ อื่น ๆ ระบุ.....

๒. ถ้ามีเงินเที่ยว มีความคิดที่จะไปเที่ยวตามดิสโก้เธค หรือลานสเก็ตที่มีดิสโก้ หรือไม่

☐ มี คิดว่าไม่เป็นเรื่องเสียหาย

☐ มี คิดว่าจะไปเพื่อหาประสบการณ์

☐ ไม่มีความคิดที่จะไปเลย

☐ อื่น ๆ ระบุ.....

๓. เคยเห็นชายหญิงแสดงบทรักกัน เช่น กอด จูบ ในที่สาธารณะ หรือตามริมถนนบ้างหรือไม่

☐ เห็นบ่อยครั้ง จนรู้สึกเป็นเรื่องธรรมดา

☐ เห็นนาน ๆ ครั้ง รู้สึกเป็นเรื่องน่าอาย

☐ ไม่เคยเห็นเลย

☐ อื่น ๆ ระบุ.....

๔. มีเพื่อนบ้าน หรือคนรู้จักทำงานเป็นหญิงโสเภณี หรือทำงานกลางคืน หรือไม่ มีความรู้สึกอย่างไร

☐ มี รู้สึกว่าเป็นเพราะความจำเป็นทางเศรษฐกิจบังคับ

☐ มี รู้สึกว่าเป็นเรื่องน่าอาย ไม่ควรคบกับหญิงเหล่านั้น

☐ ไม่มี

☐ อื่น ๆ ระบุ.....

๕. บิดา หรือ ญาติผู้ชาย เคยไปเที่ยวกลางคืน เช่น อาบอบนวด, บาร์, ไนท์คลับ หรือไม่

☐ เคย บ่อยครั้ง

☐ เคย นาน ๆ ครั้ง

☐ ไม่เคย

☐ อื่น ๆ ระบุ.....

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Appendix B (cont.)

การให้คะแนน protein consumption pattern scores

ลักษณะของการบริโภคอาหาร	คะแนน
ก. นมสด (ยกเว้นนมข้นหวาน)	
☐ ดื่มเป็นประจำทุกวัน (ระบุชนิด)..... ความถี่.....ครั้ง/วัน	๗ x จำนวนความถี่
☐ ดื่มเป็นบางวัน (ระบุชนิด)..... ความถี่.....ครั้ง/วัน	๓ x จำนวนความถี่
☐ ไม่ดื่มเลย	0
ข. เนื้อสัตว์ (ได้แก่ เนื้อหมู,ไก่,วัว,ปลา)	
☐ รับประทานทุกวัน ความถี่.....มื้อ/วัน	๗ x จำนวนความถี่
☐ รับประทานเป็นบางวัน ความถี่.....ครั้ง/สัปดาห์	จำนวนความถี่
☐ ไม่รับประทานเลย	0
ค. ไข่ (ได้แก่ ไข่ไก่, ไข่เป็ด)	
☐ รับประทาน ความถี่.....ครั้ง/สัปดาห์	จำนวนความถี่
☐ ไม่รับประทาน	0
ง. อาหารทะเล (ได้แก่ ปลาหมึก,กุ้งทะเล,หอย,ปลาทะเล)	
☐ รับประทาน ความถี่.....ครั้ง/สัปดาห์, ครั้ง/เดือน	≥ ๑ ครั้ง/สัปดาห์ = ๔ คะแนน ๑ ครั้ง/เดือน = ๑ คะแนน
☐ ไม่รับประทาน	0
จ. เครื่องในสัตว์ (ได้แก่ ตับ, หัวใจ, กระเพาะหมู)	
☐ รับประทาน ความถี่.....ครั้ง/สัปดาห์, ครั้ง/เดือน	≥ ๑ ครั้ง/สัปดาห์ = ๔ คะแนน ๑ ครั้ง/เดือน = ๑ คะแนน
☐ ไม่รับประทาน	0

การให้คะแนน sexual stimulation

ถ้าตอบรับในคำถามที่ถามเกี่ยวกับ sexual stimulation	
๑ ข้อ ได้	๑ คะแนน
๒ ข้อ ได้	๒ คะแนน
๓ ข้อ ได้	๓ คะแนน
๔ ข้อ ได้	๔ คะแนน
๕ ข้อ ได้	๕ คะแนน

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Appendix C

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Appendix C

แบบบันทึกอาหารบริโภค

คำชี้แจง (ขอให้นักเรียนอ่านเพื่อทำความเข้าใจก่อนตอบแบบสอบถาม)

แบบสำรวจนี้เป็นส่วนหนึ่งของการเก็บข้อมูล เพื่อนำไปศึกษาเกี่ยวกับอาหารที่มีผลต่อการเจริญเติบโตของเด็กวัยรุ่น (ขอให้นักเรียนบันทึกข้อมูลที่กำหนดไว้ตรงตามความเป็นจริง มิฉะนั้นจะไม่สามารถนำไปใช้ให้เกิดประโยชน์ได้ แบบสำรวจนี้ไม่มีผลต่อการเรียนการสอบของนักเรียน)

วิธีการบันทึกอาหารที่บริโภค นักเรียนจะต้องบันทึกอาหารที่บริโภคลงในตารางที่กำหนดให้ดังรายละเอียดดังนี้

๑. ก่อนที่จะทำการบันทึกให้นักเรียนนึกถึงอาหารที่ได้รับประทานว่า ได้รับประทานอาหารทั้งหมดกี่รายการ และแต่ละรายการคืออะไร

ตัวอย่าง ในมื้อเช้ารับประทานอาหารทั้งหมด ๓ รายการ คือ

รายการที่ ๑ ข้าวผัดหมู

รายการที่ ๒ ไข่ดาว

รายการที่ ๓ แกงจืดผักกาดขาวหมูสับ

๒. เมื่อบันทึกรายการอาหารแล้ว ให้นึกดูว่าแต่ละรายการของอาหารนั้นประกอบไปด้วยอาหารประเภทไหน แล้วบันทึกรายละเอียดอาหารที่รับประทาน

ตัวอย่าง รายการที่ ๑ ข้าวผัดหมูประกอบไปด้วย - ข้าวสวย
- หมู
- น้ำมันหมู

รายการที่ ๒ ไข่ดาวประกอบไปด้วย - ไข่ไก่
- น้ำมันหมู

รายการที่ ๓ แกงจืดผักกาดขาวหมูสับประกอบด้วย - ผักกาดขาว
- หมูสับ

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๓. เมื่อได้ประเภทของอาหารแล้วให้นึกต่อไปถึงปริมาณของอาหารแต่ละประเภทที่รับประทานเข้าไป โดยกะปริมาณอาหารแต่ละประเภทนั้นนักเรียนรับประทานเป็นปริมาณเท่าใด จากรูปภาพสัดส่วนอาหารที่แจกให้ ถ้าหากมีอาหารที่นอกเหนือจากรูปภาพ ให้ระบุอย่างชัดเจนว่าเป็นปริมาณเท่าใด เช่น ๑ ช้อนชา, ๒ ช้อนโต๊ะหรือมีขนาด ๓-๔ นิ้ว

๔. ในกรณีที่ดื่มเครื่องดื่ม เช่น นม น้ำหวาน น้ำอัดลม ให้บันทึกด้วย (ยกเว้นน้ำเปล่า)

๕. ถ้ารับประทานอาหารประเภทก๋วยเตี๋ยว หรือบะหมี่ ที่ต้องใส่เครื่องปรุง เช่น น้ำตาล ให้ระบุปริมาณของน้ำตาลว่าเติมกี่ช้อนด้วย

ชื่อ.....นามสกุล.....

ชั้น.....โรงเรียน.....

วันที่บันทึก.....เดือน.....พ.ศ.....

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ตัวอย่าง รายละเอียดของอาหารมื้อเช้าที่นักเรียนรับประทาน

รายการอาหาร	ประเภทอาหาร	ปริมาณอาหาร	ปริมาณอาหารจากการสัมภาษณ์(สำหรับผู้สำรวจ)
รายการที่ ๑ ข้าวผัดหมู	ข้าวสวย	๑ จาน	
	น้ำมันหมู	๑ ช้อนชา	
	หมู	๓ ชิ้น	
	แตงกวา	๔ ชิ้น	
รายการที่ ๒ ไข่ดาว	ไข่ไก่	๑ ฟอง	
	น้ำมันหมู	๑ ช้อนชา	
รายการที่ ๓ แกงจืดผักกาดขาวหมูสับ	ผักกาดขาว	๒ ช้อนโต๊ะ	
	หมูสับ	๓ ก้อน	
	กระเทียมเจียว	๑ ช้อนชา	

หมายเหตุ การบันทึกอาหารที่นักเรียนรับประทานในมื้ออื่น ๆ ก็บันทึกเช่นเดียวกันกับตัวอย่างการบันทึกอาหารมื้อเช้า

ข้อมูลเกี่ยวกับอาหารบริโภค

จงกาเครื่องหมายถูก (✓) ลงใน ☐ ให้ตรงกับความจริง

ส่วนที่ ๑ รายละเอียดเกี่ยวกับการบริโภคอาหารมื้อเช้า ตั้งแต่ตื่นนอนถึง ๑๑.๐๐ น.

๑. วันนี้รับประทานอาหารมื้อเช้าพิเศษกว่าวันอื่น ๆ หรือไม่

☐ พิเศษ

☐ เหมือนปกติ

☐ อื่น ๆ (ระบุ).....

๒. วันนี้มีอาการไม่สบายหรือเจ็บป่วยหรือไม่

☐ เจ็บป่วย (ระบุโรคที่เป็น).....

☐ ปกติ

☐ อื่น ๆ (ระบุ).....

๓. สถานที่นักเรียนรับประทานอาหารมื้อเช้า

☐ ที่บ้าน

☐ โรงเรียน

☐ อื่น ๆ (ระบุ).....

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รายการอาหาร	ส่วนประกอบของอาหาร	ปริมาณอาหาร	ปริมาณอาหารจากการสัมภาษณ์ (สำหรับผู้สำรวจ)
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<u>ส่วนที่ ๒</u> รายละเอียดเกี่ยวกับการบริโภคอาหารมื้อกลางวันตั้งแต่เวลา ๑๑.๐๐น.ถึง ๑๕.๓๐น.

๑. สถานที่นักเรียนรับประทานอาหารมื้อกลางวัน

☐ ที่บ้าน

☐ โรงเรียน

☐ อื่น ๆ (ระบุ).....

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รายการอาหาร	ส่วนประกอบของอาหาร	ปริมาณอาหาร	ปริมาณอาหารจากการสัมภาษณ์ (สำหรับผู้สำรวจ)
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<u>ส่วนที่ ๓</u> รายละเอียดเกี่ยวกับอาหารมื้อเย็นตั้งแต่เวลา ๑๕.๓๐ น.- ๒๐.๐๐ น.

๑. สถานที่รับประทานอาหารมื้อเย็น

☐ ที่บ้าน

☐ ร้านค้า

☐ อื่น ๆ (ระบุ).....

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ส่วนที่ ๔ รายละเอียดเกี่ยวกับอาหารที่รับประทานตั้งแต่เวลา ๒๐.๐๐ น. จนกระทั่งเข้านอนให้นักเรียนบันทึกรายละเอียดของอาหารก่อนนอนแต่ละรายการที่รับประทาน

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Appendix D

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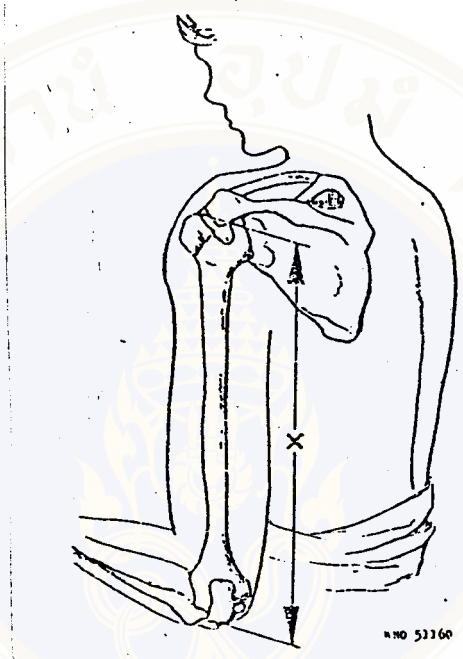
Appendix D

Fig. 1D Assessing midpoint of upper arm (Halfway between the acromial process of the scapula and the olecrenon preocess of the ulna)



(From Jelliffe, 1966)

Fig. 2D Harpenden skin-fold calipers

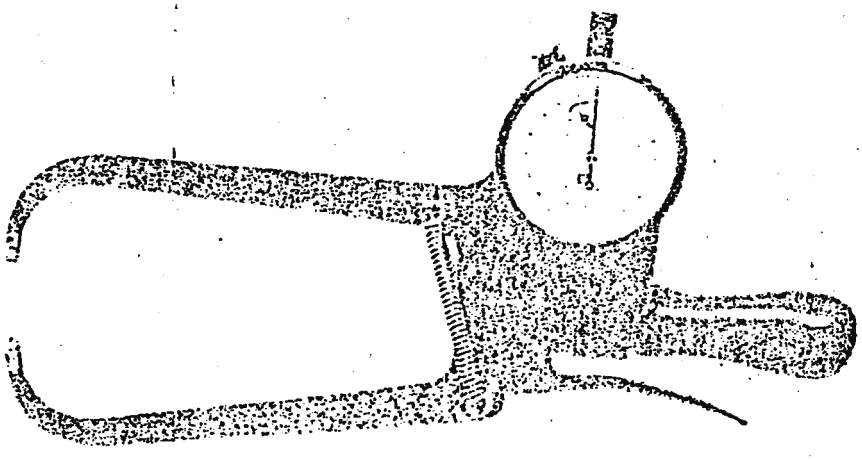


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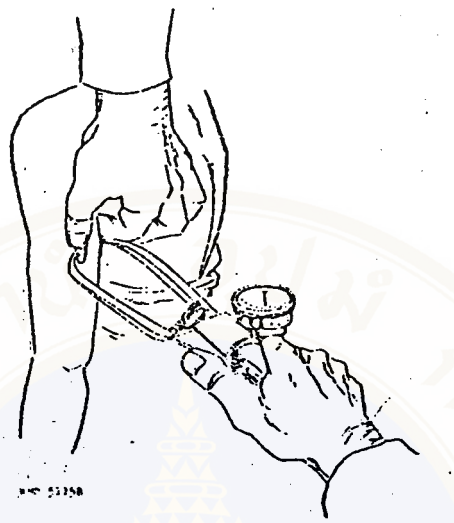
Fig. 3D Measurement of triceps skin-fold with harpenden calipers.



(From Jelliffe, 1966, p. 75)

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Appendix E

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Appendix E

Table 1E Daily dverage energy requirement and safe level of protein intake for adolescent's girls aged 10 - 18 years.

Age (years)	Median weight (kg)	Median height (cm)	Daily energy requirement * (kcal)	Safe level of Protein intake * (g/kg)
Girls				
10-12	36	145	1950	1
12-14	46.5	157	2100	0.95
14-16	52	161	2150	0.9
16-18	54	163	2150	0.8

*WHO, 1985

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Table 2E แสดงค่าปกติน้ำหนัก (กิโลกรัม) และส่วนสูง (เซนติเมตร) ของเด็กวัยเรียนหญิง จากการศึกษาของ นายแพทย์บูรณะ ชวลิตธำรง และคณะ

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หมายเหตุ ค่าปกติของน้ำหนักและส่วนสูง ได้จากตารางน้ำหนัก ส่วนสูง ของเด็กนักเรียนในกรุงเทพมหานคร โดยถือค่าเฉลี่ยที่ Percentile ที่ ๕๐ และที่ ๑๐ เป็นค่าปกติ ค่าที่ต่ำกว่าที่แสดงในตารางถือว่า ขาดโปรตีนและกำลังงาน

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Appendix F.

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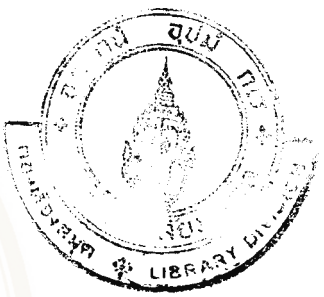
Appendix F

X^2 - test

1. Test for Goodness of Fit (Normal distribution)

$$\chi^2 = \sum \frac{(Oi - Ei)^2}{Ei} \quad , \quad i = 1, \ldots, r$$

$$d.f. = r - 3$$



2. Test of Homogeneity

$$\chi^2 = \sum\sum \frac{(Oij - Eij)^2}{Eij}$$

$$d.f. = (r - 1)(c - 1)$$

$$Eij = \frac{RiCj}{n}$$

T - test เมื่อ $\sigma_1^2 \neq \sigma_2^2$

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S_{\bar{X}_1 - \bar{X}_2}}$$

$$d.f = \frac{\left(\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}\right)^2}{\frac{1}{n_1+1}\left(\frac{S_1^2}{n_1}\right)^2 + \frac{1}{n_2+1}\left(\frac{S_2^2}{n_2}\right)^2} - 2$$

$$S^2_{\bar{X}_1 - \bar{X}_2} = \frac{S_1^2}{n_1} + \frac{S_2^2}{n_2} \quad ,$$

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ANOVA of one - way Classification

1. Correction term (CT)

$$CT = \frac{T_{....}^2}{abcn}$$ (n = ขนาดของตัวอย่าง, =จำนวนชุดของตัวอย่าง)

2. Total sum of square

$$SS_T = \Sigma\Sigma\Sigma X_{ijk}^2 - CT$$

3. Treatment sum of square

$$SS_t = \Sigma\Sigma\Sigma \frac{T_{ijk..}^2}{n} - CT$$

$$SS_a = \Sigma\Sigma \frac{T_{i..}^2}{bcn} - CT$$

$$SS_b = \Sigma\Sigma \frac{T_{j...}^2}{acn} - CT$$

$$SS_c = \Sigma\Sigma \frac{T_{..k.}^2}{abn} - CT$$

$$SS_{ab} = \Sigma\Sigma \frac{T_{ij}^2}{cn} - CT - SS_a - SS_b$$

$$SS_{ac} = \Sigma\Sigma \frac{T_{i.k.}^2}{bn} - CT - SS_a - SS_c$$

$$SS_{bc} = \Sigma\Sigma \frac{T_{.jk.}^2}{an} - CT - SS_b - SS_c$$

$$SS_{abc} = SS_t - SS_a - SS_b - SS_c - SS_{ab} - SS_{ac} - SS_{bc}$$

4. $SS_c = SS_T - SS_t$

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5. ANOVA table

Source of variable	df	SS	$MS = \frac{SS}{df}$	F
Treatment	abc-1	SS_t	-	-
A	a-1	SS_a	MS_a	$MS_a \div MS_e$
B	b-1	SS_b	MS_b	$MS_b \div MS_e$
C	c-1	SS_c	MS_c	$MS_c \div MS_e$
AB	(a-1)(b-1)	SS_{ab}	MS_{ab}	$MS_{ab} \div MS_e$
AC	(a-1)(c-1)	SS_{ac}	MS_{ac}	$MS_{ac} \div MS_e$
BC	(b-1)(c-1)	SS_{bc}	MS_{bc}	$MS_{bc} \div MS_e$
ABC	(a-1)(b-1)(c-1)	SS_{abc}	MS_{abc}	$MS_{abc} \div MS_e$
Error	abc(n-1)	SS_e	MS_e	-
Total	abcn - 1	SS_t	-	-

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Pearson Product Moment Correlation Coefficient (r)

$$r = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{\left[N\sum X^2 - (\sum X)^2\right]\left[N\sum Y^2 - (\sum Y)^2\right]}}$$

X = ผลรวมของข้อมูลที่วัดได้จากตัวแปร X

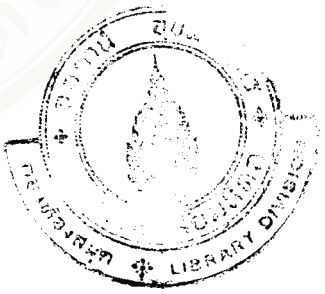
Y = ผลรวมของข้อมูลที่วัดได้จากตัวแปร Y

XY = ผลรวมของผลคูณระหว่างค่าของตัวแปร X และ Y

X^2 = ผลรวมของกำลังสองของข้อมูลจากตัวแปร X

Y^2 = ผลรวมของกำลังสองของข้อมูลจากตัวแปร Y

N = จำนวนข้อมูล หรือจำนวนคนในกลุ่มตัวอย่าง



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